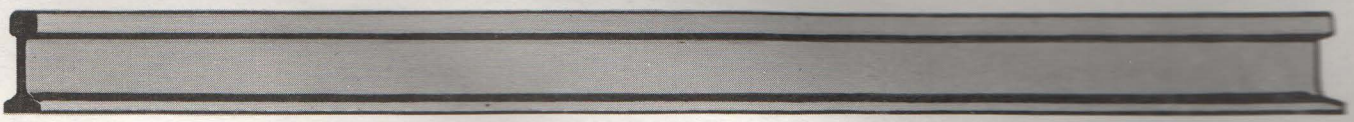
SYDNEY
RAILROAD RAILS

SYDNEY RAILS ARO

ND THE WORLD
RUSSIA
IRAQ
PAKISTAN
KOREA
INDIA
ODESIA
SOUTH AFRICA



1767

Cast Iron Plate — 5 ft. long

1776-1793

Cast Iron Rail — 3 ft. long

1789

At Supports *Between Supports*

Cast Iron Edge Rail - Fish-Bellied Plate

1797

Cast Iron Edge Rail

1802

Cast Iron Rail — 4½ ft. long

1808

Cast Iron Rail

1808-1811

Malleable Iron Rail

1816

Cast Iron Edge Rail

1820

26 lb.

Birkenshaw Rolled Iron Rail

1830

33 lb.

Clarence Rolled Iron Rail

1831

Robert L. Stevens Tee-Rail

1831

41 lb.

P. R. R. Amboy Div.

1835

40 lb.

U or Bridge Rail

1837

58 lb.

Lock Rail

1844

Bullhead Rail

1844

40 lb.

Evans U Rail

1845

First U. S. Tee-Rail

1858

85 lb.

P. R. R. Std.

1864

67 lb.

P. R. R. Std.

1865

50 lb.

First Bessemer Rail Rolled in U. S.

1876

60 lb.

1900

100 lb.

1916

130 lb.

1930

131 lb.

1933

112 lb.

1946

140 lb.

1947

115 lb.

1947

132 lb.

1947

133 lb.

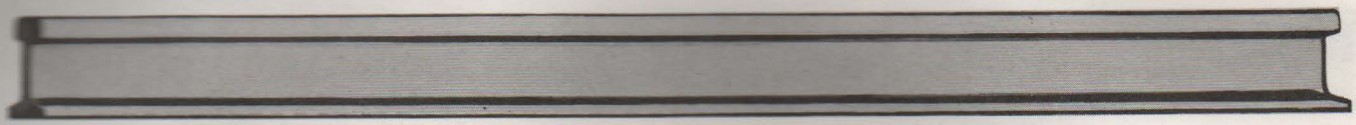
1947

Height 8 in.
Base 6¼ in.

155 lb.

CHRONOLOGICAL DEVELOPMENT OF THE CROSS SECTION OF THE RAIL

Reproduced by Courtesy of A.I.S.I.



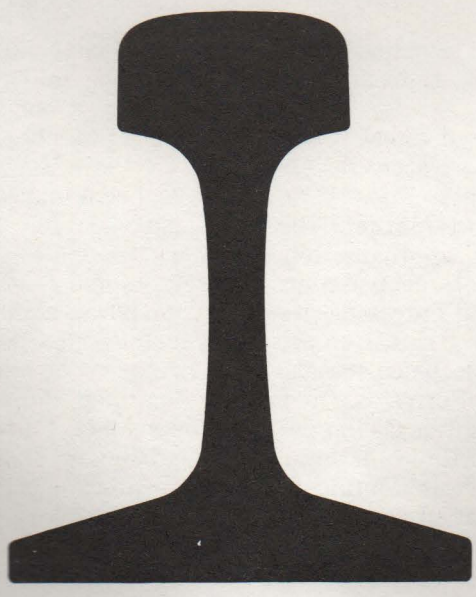
EVOLUTION OF THE STEEL RAIL

HISTORY records evidence of a "rail" as early as 1767, but it was not until 1831 that a rolled iron rail resembling our present day tee-rail was introduced. This tee-shaped section was followed in turn by a bullhead rail, a rail shaped like an inverted U, and a pear-shaped rail. This trend soon turned back to a form of the tee-rail and there gradually evolved the design known today as the standard tee-shaped section.

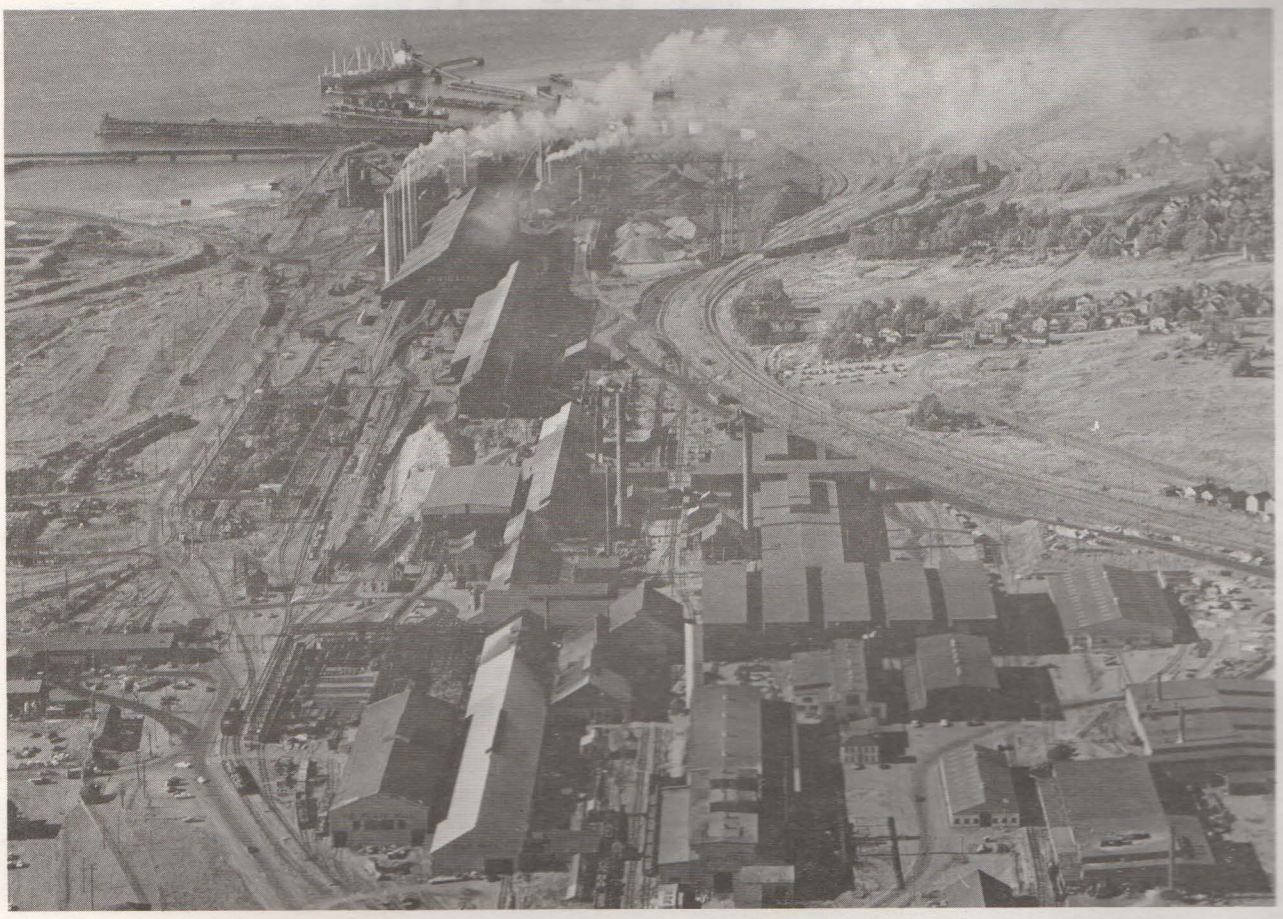
In the latter half of the nineteenth century, the Bessemer method of steel-making was introduced and in 1865 the first all-steel rails were produced by this process. Bessemer rails continued as the accepted standard until the open hearth process of steelmaking developed early in 1900. With this development, Open Hearth rails replaced Bessemer rails as the accepted standard in North America, but Bessemer rails are still approved in some areas outside this continent.

With the introduction of the all-steel rail and steadily increasing traffic loads, there arose a demand for larger and heavier rail sections, until today we have specifications calling for rails up to 155 lb. per yard (76.9 Kg-M).

By definition the standard rail is a section, symmetrical about its vertical axis, which consists of three areas: the base, the web and the head. The term "tee" is used to describe this general class of rails resembling the letter T.



SYDNEY STEEL WORKS



The Sydney Steel Corporation at Sydney, Nova Scotia, Canada has been producing railroad rails since 1905.

Sydney Works is an integrated steel plant situated on a 440 acre site at tide water. Its excellent harbour and docking facilities make it an ideal shipping point for the export market. The plant has an ingot capacity of approximately 1,000,000 tons (910,000 metric tons) of steel per year.

Raw materials, such as coal and limestone are supplied from nearby mines and quarries. Iron ore and coal are brought to Sydney in deep-sea vessels.

Primary facilities include Blast Furnaces, Open Hearths, a Vacuum Degassing Plant, a 450 ton per day Oxygen Plant, Rolling Mills, a Rail Mill and a Modern Rail Finishing Mill. Two Continuous Casting Machines will be in operation in 1974.

The raw materials, coal and iron-ore, are initially processed in the Coke Ovens and Blast Furnaces, respectively, to produce the molten iron used in our Open Hearth furnaces. The high-quality steel produced in the Open Hearth Department is further processed in our Rolling Mills to be sold as semi-finished product or as either Reinforcing Bar, Rail or Tie Plate. Rails produced at the Sydney Works have been marketed in the past under various brands—Dosco, Dominion, etc.—but are now marketed under the brand "Sydney".

Additional facilities at Sydney Works include a steam power plant with a capacity of 35,000 KW and a foundry producing ingot moulds and domestic castings.

Auxiliary equipment consists of a Machine Shop, Boiler Shop, Pattern Shop, Car Repair and Electrical Repair Shops.

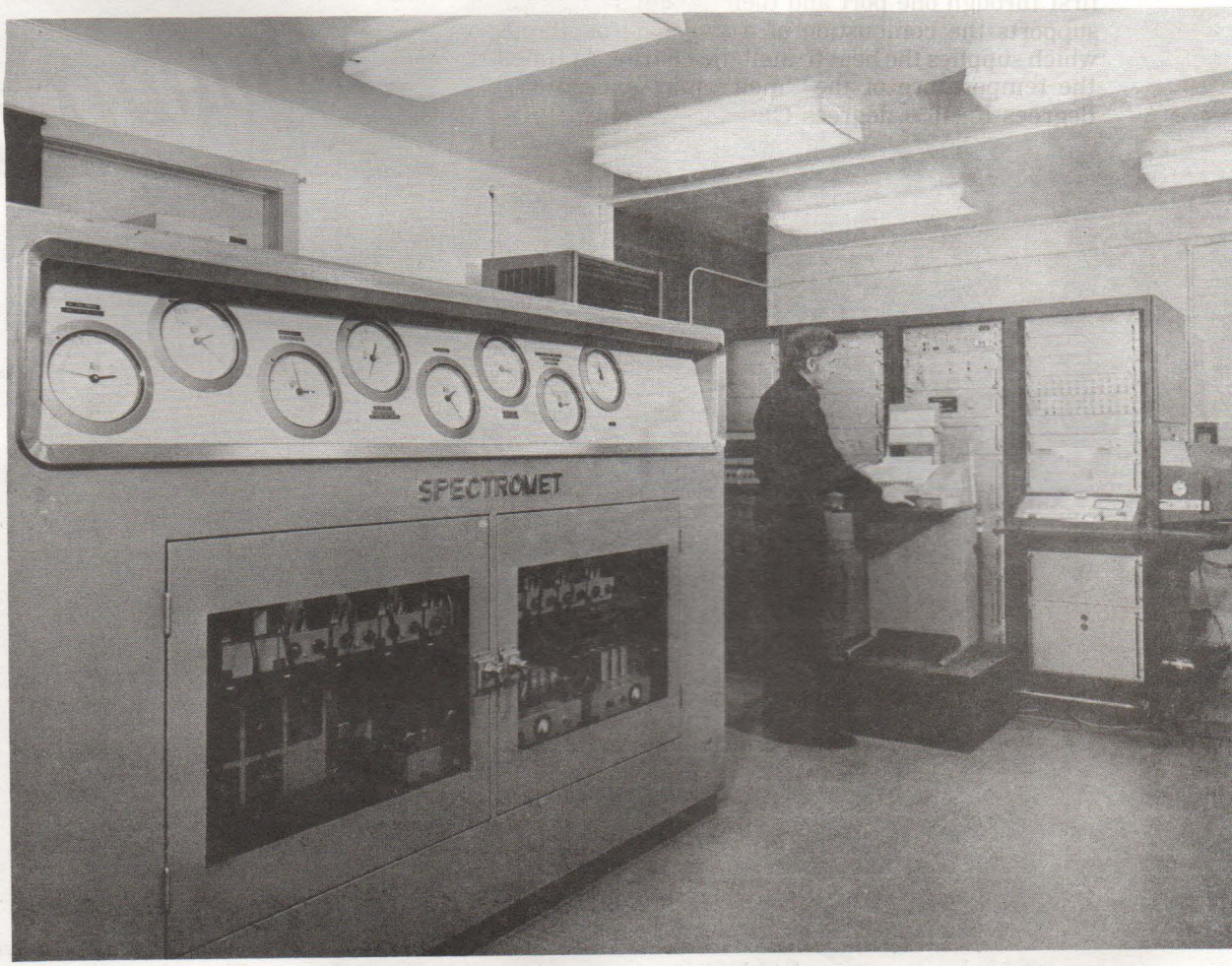
The many operations carried on require the daily use of 65,000,000 gallons of water (50,000,000 salt and 15,000,000 fresh), and are serviced by approximately 50 miles of Corporation-owned railway track and approximately 250 units of rolling stock.

STEEL FOR SYDNEY RAILS

The production of first quality steel is the initial step in the manufacture of steel rails. For many years the Open Hearth process has been the accepted North American method for the production of this steel. Although in recent years, other steel making processes have gained acceptance, for example, BOF (L.D.).

At the Sydney Works, five Open Hearth furnaces, one currently equipped with Sydney's own SIP, (Submerged Injection Process), are all using basic linings to produce the high quality grades of rail steel for today's railroads.

The selected materials charged into the furnace are heated to approximately 3000 degrees F., and this heat causes an intense reaction which eliminates much of the unwanted carbon, phosphorus and sulphur. Continuous sampling by laboratory technicians ensures that the steel comes to the end of its cycle metallurgically suited to meet the meticulous specifications outlined by the consumer.

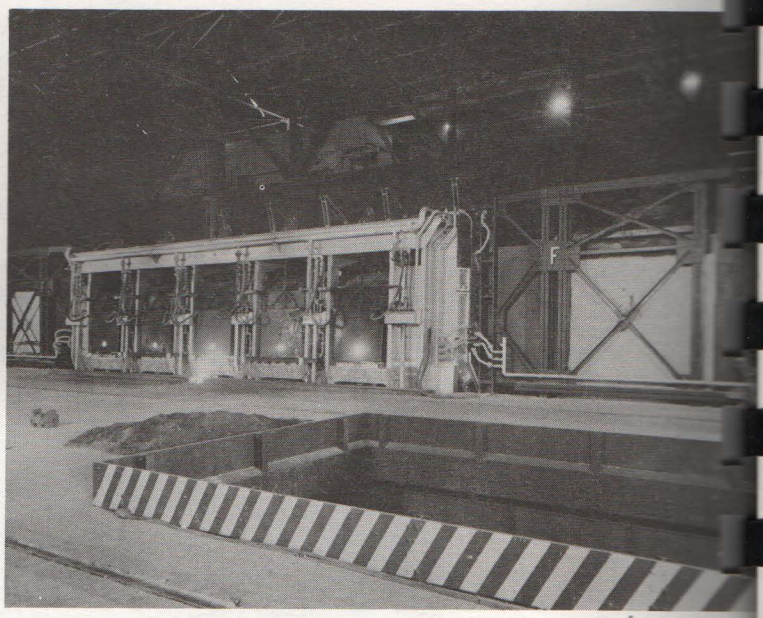


Modern methods of chemical control are carried out at Sydney Steel Plant. The spectrographic equipment shown is used in the chemical control of steel production and is capable of simultaneously analyzing for sixteen separate elements in approximately 60 seconds.

THE OPEN HEARTH

A Sydney open hearth furnace is about 92 ft. (28 M) long and 25 ft. (7.6 M) wide. The dish-like furnace bottom is called a "hearth" and is formed of basic refractory material supported by a steel framework. The walls and roof are also made of refractory material within a steel frame. Furnace size is usually expressed in tons of steel per heat, or "melt", and this in turn is governed by the size of the "hearth". Sydney's open hearth furnaces have capacities varying from 190 tons (172 metric tons) to 250 tons (225 metric tons).

In operation the open hearth furnace is charged with limestone, scrap metal and pig iron and preheated air is introduced, in alternating periods, first through one port and then the other. This air supports the combustion of a sweeping oil flame which supplies the heat to melt the charge. At times the temperature of the "melt" may exceed 3000 degrees F (1650 degrees C).



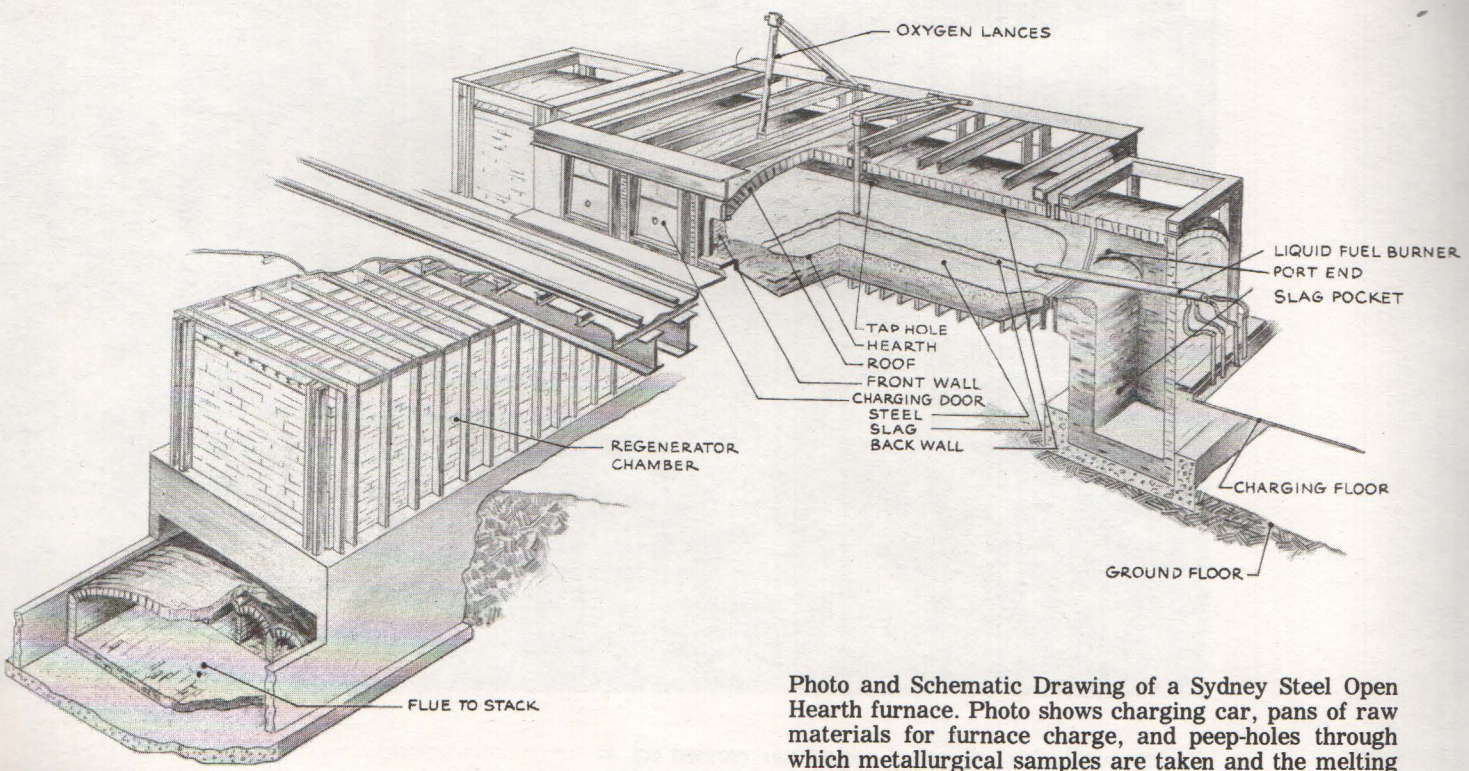
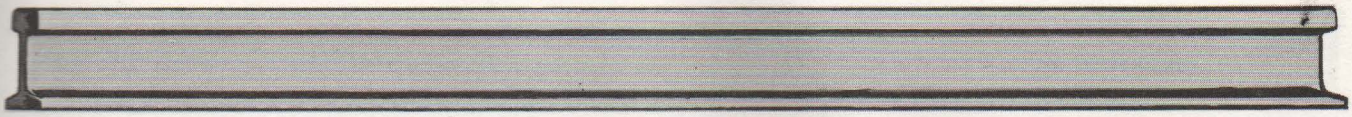


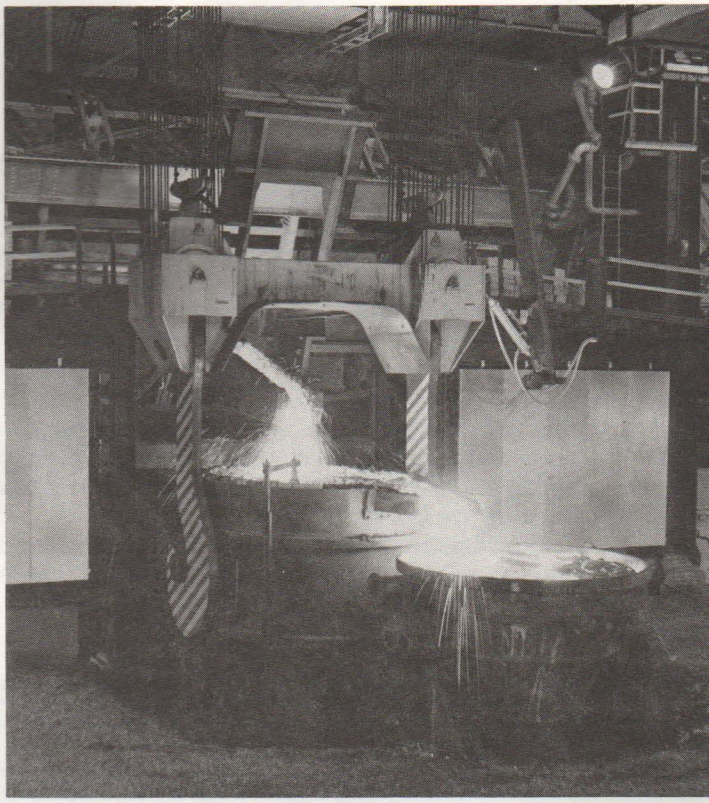
Photo and Schematic Drawing of a Sydney Steel Open Hearth furnace. Photo shows charging car, pans of raw materials for furnace charge, and peep-holes through which metallurgical samples are taken and the melting process observed.



A RAIL HEAT

Great care must be exercised in making steel for rails and this care starts with the selection of raw materials for the open hearth charge. Following the initial melt down of scrap and limestone, pig iron in the molten state, is added to the furnace and the high furnace temperature attained soon converts all materials to a white hot bubbling bath.

This melt-down is followed by a refining period, and great skill and judgment are needed by the steelmaker as the processing moves toward the chemical requirements dictated by the ruling specification. This skill is necessary so that the percentages of Carbon, Manganese, Silicon, Phosphorous and Sulphur may be controlled within the designated limits of the rail specification. The percentage of each of these elements may vary with the weight of rail section to be rolled.



Basic steel-producing Open Hearth furnaces at Sydney, N.S. are of the tilting variety, oil fired with basic lining. Shown is a 225-ton furnace being tapped. This furnace is one of five included in the department.

LIMITS OF CHEMICAL ANALYSES FOR SPECIFICATION

SPECIFICATION DATE	lbs./yd.	C	Mn	Si	P	S	Kg/M approx.
*A.R.E.A. – 1970	91 - 120	.67/.80	.70/1.00	.10/.25	.04 Max.	.05 Max.	45.1-59.5
Canadian National 1972	132	.69/.82	.70/1.00	.10/.25	.04 Max.	.055 Max.	65.52
Canadian Pacific – 1969	115	.67/.80	.70/1.00	.10/.25	.04 Max.	.055 Max.	57.0
**B.S. 11 – 1959	110	.50/.60	.95/1.25	.08/.20	.06 Max.	.06 Max.	54.6
***U.I.C. – 1970 .A 860 - 1	75 - 140	.60/.75	.80/1.30	.50 Max.	.05 Max.	.05 Max.	37.20-69.74
***U.I.C. – 1970 B. 860 - 1	75 - 140	.50/.70	1.30/1.70	.50 Max.	.05 Max.	.05 Max.	37.20-69.74

* A.R.E.A. – American Railway Engineering Association

** B.S. – British Standard

*** U.I.C. – International Union of Railways

TAPPING AND VACUUM TREATMENT

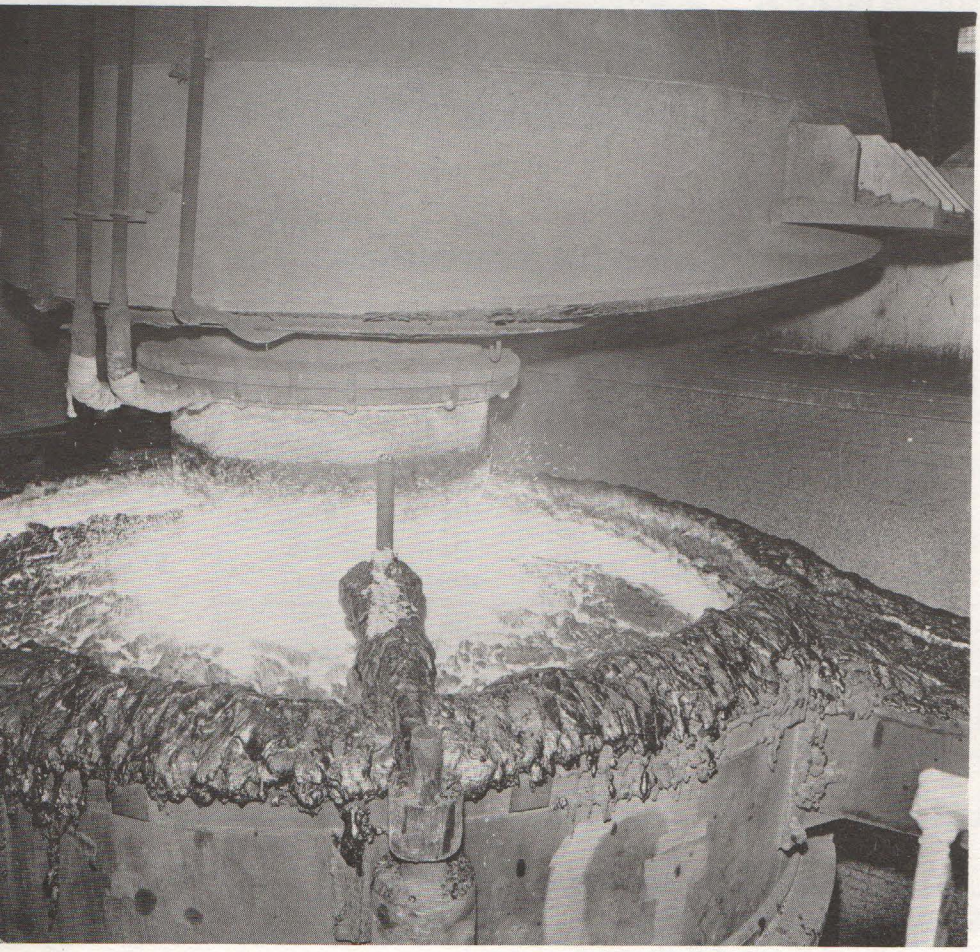
At the end of the refining period the molten steel is tapped into a large refractory-lined ladle and from here it is vacuum treated or degassed. Heats of Molten Steel to be degassed are partially de-oxidized during the tapping. All of the ferro silicon (Fe Si) and additions of ferro manganese (Fe Mn) and carbon will be made at the degasser.

A temperature and sample for analysis are taken prior to commencing the degassing treatment. With this information, the operator determines the amount of alloys to be added to meet the strict specification and any limitations on the treatment time by temperature.

The vacuum vessel is lowered so that the snorkel enters the molten steel; the steam jet ejectors create a vacuum in the vessel which causes the steel to be drawn into the chamber for degassing. The vessel is raised and the steel runs out. This cycle is repeated approximately 25 to 30 times, giving 2½ recirculations of the steel in the ladle.

Alloys are added, through a series of vacuum locks, when the vessel is in its lowest position. The timing of the additions relative to the position of the vessel is controlled by a series of electrical interlocks. With treatment completed, the vessel is purged with nitrogen and then raised to clear the snorkel out of the ladle. The ladle is then removed for conventional ingot teeming.

It is this process, or one quite similar, which is used in the production of special quality forging steels.

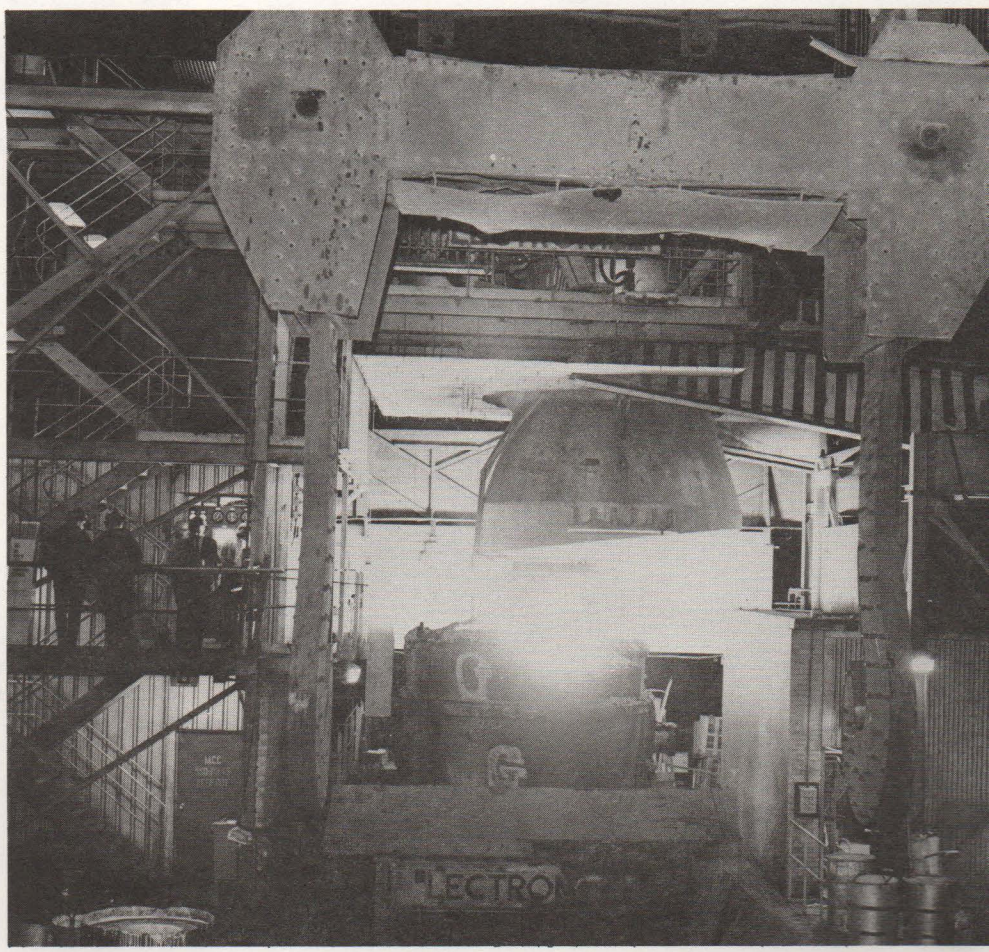


Shown in this photo-graph is a close up of the snorkel of the vacuum vessel entering the molten steel.

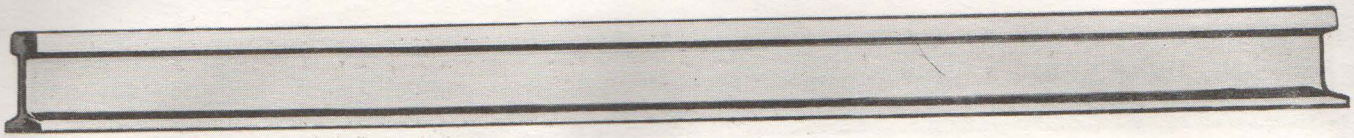
VACUUM TREATMENT (Continued)

THE EFFECTS OF VACUUM TREATMENT:

1. **Hydrogen Removal**
   Two and one-half recirculations, as outlined on the preceding page, will virtually guarantee less than 2½ p.p.m. of Hydrogen (H2), a level well below the critical content required to cause flaking (shatter cracks) in steel of rail composition and section, thereby eliminating the need for controlled cooling.
2. **Analysis**
   Vacuum degassing permits far more accurate analysis control.
3. **Uniformity**
   Vacuum degassing, by the very fact that it causes a stirring effect during the process, produces a more uniform analysis.
4. **Ingot Quality**
   A more uniform temperature is achieved, again by the stirring action in the ladle, which permits lower teeming temperatures with consequent improvement in Ingot quality.
5. **Nitrogen Reduction**
   Vacuum degassing has lowered nitrogen content as much as 15 percent.



The photograph to the right shows the Lectromelt Vacuum Treatment facilities.

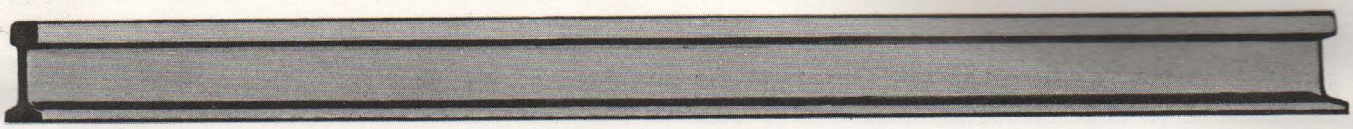


TEEMING

After vacuum degassing, or treatment, the ladle is poured (teemed) into open-topped ingot molds. These molds, big-end-down, have corrugated sides and are tapered. The height of the specific ingot poured varies with the different section of rail to be rolled, but in most cases will be approximately 90" (228.6mm) high and weigh about 7½ tons, (6¾ metric tons). The height of pour depends chiefly on the rail-per-ingot ratio most practical for Mill processing of the ingot.

The steel is allowed to cool and solidify in the molds and is then moved to the "stripper" where the normal contraction of the steel on cooling allows easy removal of the mold from the steel ingot. During stripping and in transfer to the soaking pits, the surface of the ingots cools appreciably, while the interior usually remains above rolling temperature. To assure a uniform rolling temperature, these ingots are now "soaked" or held in heated pits at a controlled temperature for a specified time. When the proper rolling temperature is reached, they are individually removed from the soaking pits by a crane and delivered to the blooming mill rolls by "chariot".

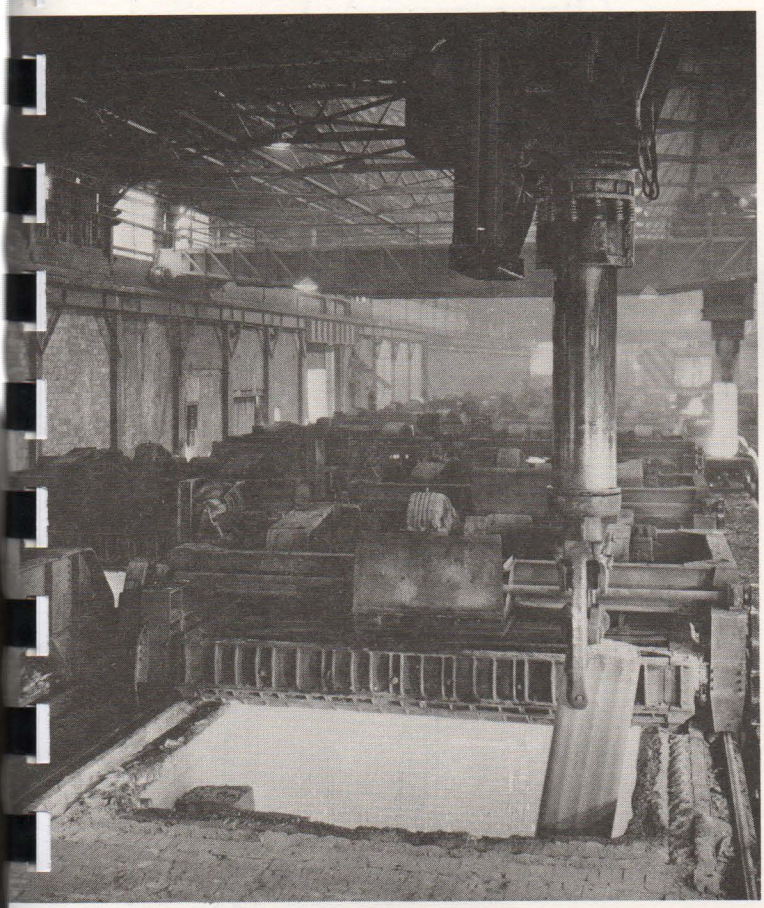
Teeming a heat of steel at Sydney Works from 200 ton ladle into ingot molds. After solidification the molds are removed or "stripped" from the hot ingots.



STEEL INGOTS TO STEEL RAILS

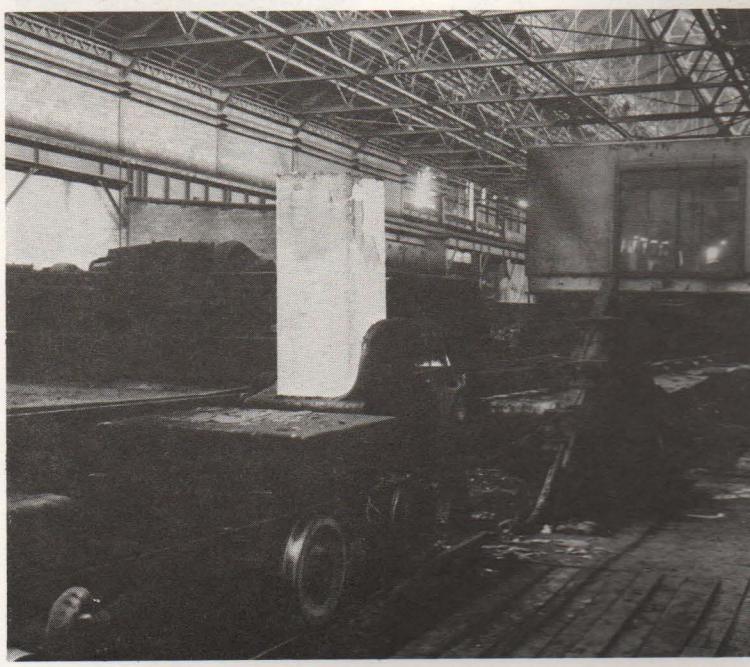
The rail steel ingot on the "chariot" is fed top end first to a two-high reversing blooming mill which is powered by twin motor drives. In this mill the original cross section is reduced to an approximate 8 to 9 inch section (203-228 mm). This reduction is accomplished by a series of forward and backward passes, on alternate sides of the ingot, whereby in about 11 passes the desired cross sectional size is obtained and the elongated progress from about 7 ft. (2.1 M) to about 50 to 60 ft. (15-18M).

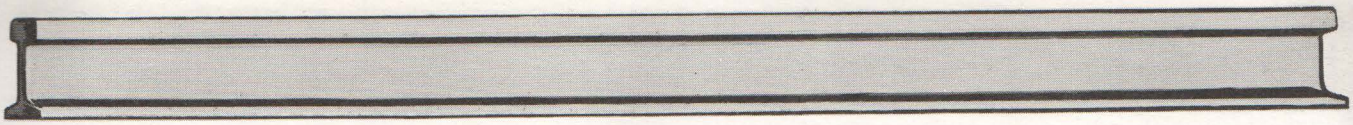
The resulting rail bloom is now subjected to a top and bottom discard sufficient to ensure sound and clear steel. The remainder of the bloom is sheared to a length which will produce one 82 ft. (25 M) rail. The length and size of the blooms are governed by the rail section to be rolled and this in turn determines the height of ingot that will be teemed to give the best rail-to-ingot ratio.



Pictured at left, in foreground — pit cover open. The overhead crane is shown charging an ingot into the blooming Mill Soaking Pit to be brought up to rolling temperature. In the background, the overhead crane is removing an ingot and placing it on the "chariot".

Below — a closer view of the "chariot" or buggy which carried the ingot, now at rolling temperature from the Soaking Pits to the Blooming Mill.





STEEL INGOTS TO STEEL RAILS *(Continued)*

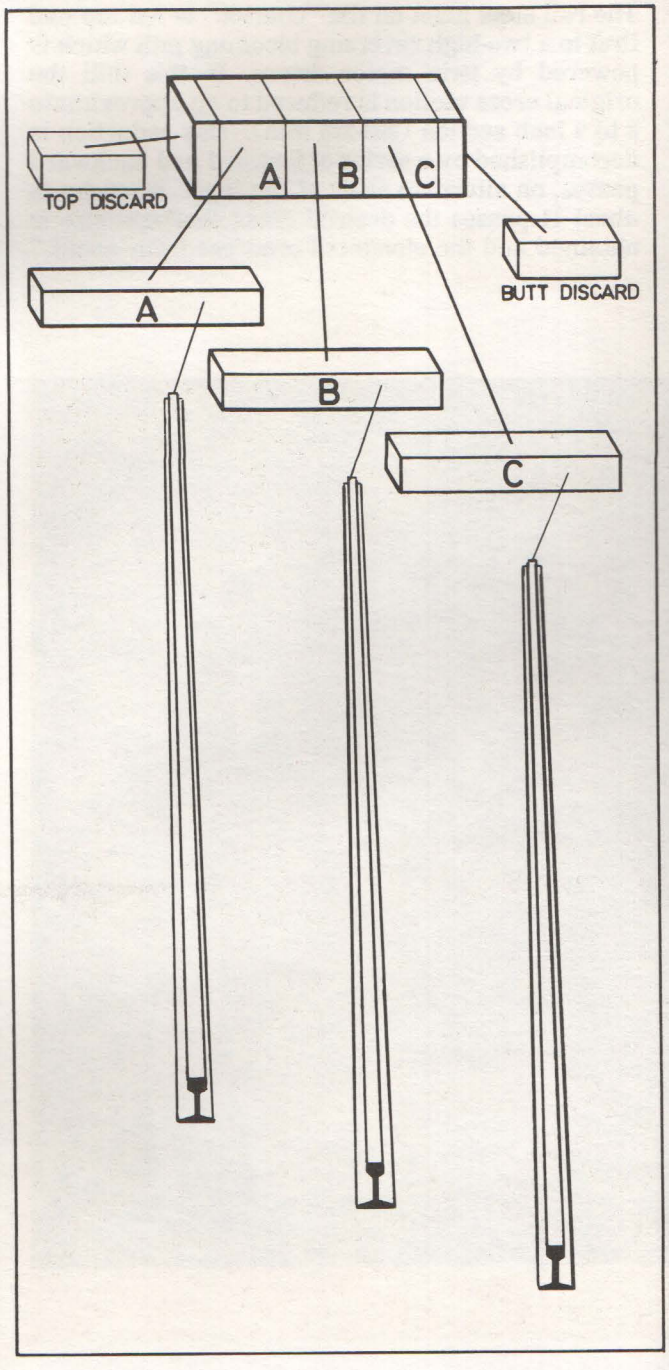
The top bloom of each ingot is cut somewhat longer than normal in order to provide additional length of rail from which "nick & break" tests (to be discussed later) are cut.

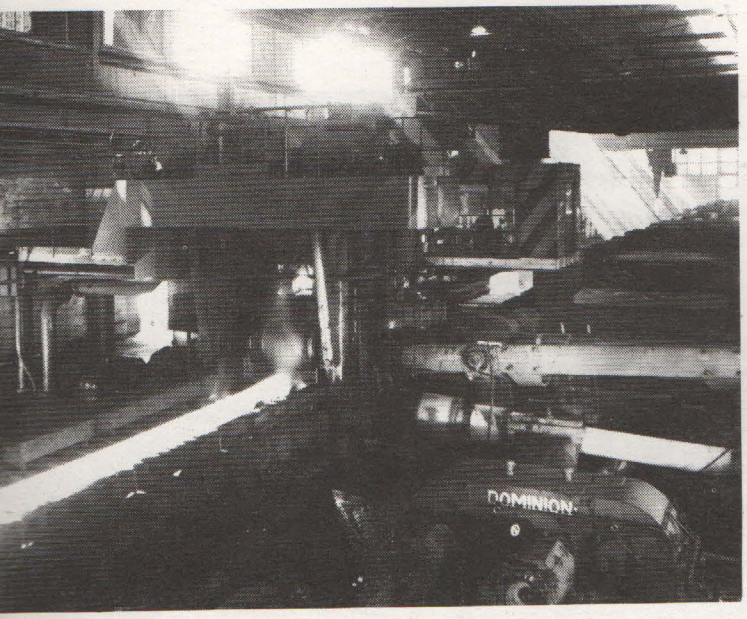
Drop-test ingots, which also supply material for chemical and mechanical testing, are poured about 200 lbs. (100 Kg) heavier than ordinary ingots.

Each ingot is poured to produce a certain number of rails. To produce 78' rails, the ingot when rolled is cut into 5 pieces, two pieces are discarded. The three remaining blooms are serial lettered A-B and C. This indicates the top, second and end rail from each ingot.

The sketch, at right, shows this in graphic form. When the bloom is rolled into rail, the serial letter goes with the appropriate rail produced.

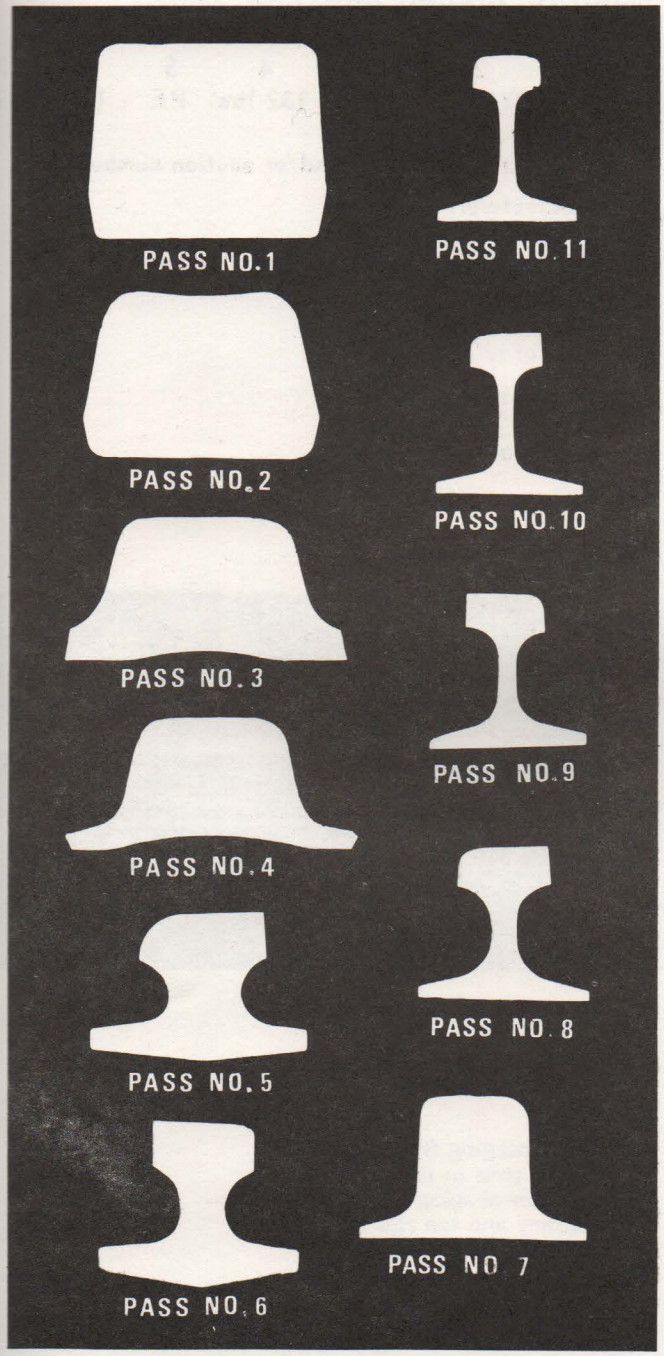
The "cut to size" rail blooms are now charged into a reheating furnace and heated for about one hour to a uniform temperature of approximately 2100 degrees F. (1150 degrees C.) before being transferred to the rail rolling mill.





Section of the blooming mill showing an ingot in the background and in the foreground the final step in the elongation of the ingot into a rail bloom.

STEEL INGOTS TO STEEL RAILS *(Continued)*



Typical pass contour during the rolling of a rail.

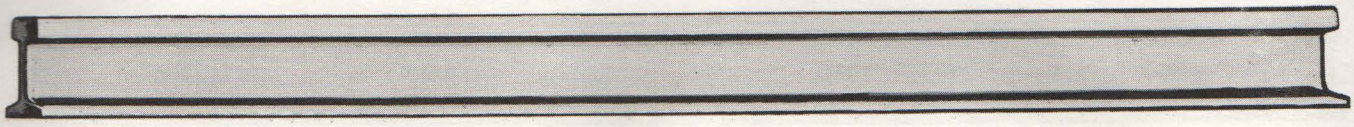
In the rail mill the bloom is broken down and the rail section is formed by a series of eleven passes, so designed that the bloom is progressively formed into the contour and shape of the desired rail section.

Rail specifications are so exacting that utmost precision is necessary in the initial roll design, and in the subsequent inspection which is given to the rolled rail with respect to section, size and contour.

When a "new mill" is set up, or before a new section is rolled, a trial run of several blooms is made in order to ensure strict adherence to specifications. Checks are made of the width and contour of the base and head, the flange length and thickness, the height, base flatness and the "Fish" fit. Only when all specifications are met is the rolling allowed to proceed.

During the rolling all the above mentioned dimensions are checked continuously and an additional inspection is made for underfills, overfills, roll marks, guide marks, cracks and seams. At this time the surface is also checked for "cleanliness", and when any roughening of the "fillet" appears, the finishing pass is renewed.

Prior to rolling, all rail length measurements between the hot saw and the end stop are carefully checked. These measurements take into consideration the shrinkage allowances which must be made to produce (when cold) the desired rail length. The temperature of the rail is recorded by a Rayotube focused on the rail head as it leaves the finishing pass.



RAIL IDENTIFICATION

Rail specifications state that each individual rail be identified as to manufacturer, month and year rolled, section designation, heat number, ingot number and the rail letter. Some specifications also ask that the rail bear an "arrow" pointing in direction indicating the top of the ingot.

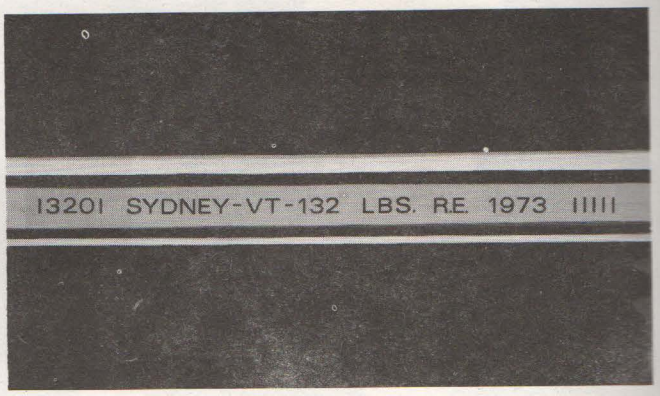
Ingots are initially identified in the open hearth in order of pour and this identity is maintained through all future processing. In the Blooming Mill, the identity of the blooms, charged to the reheating furnace and the delivery of these blooms to the rail mill is further recorded.

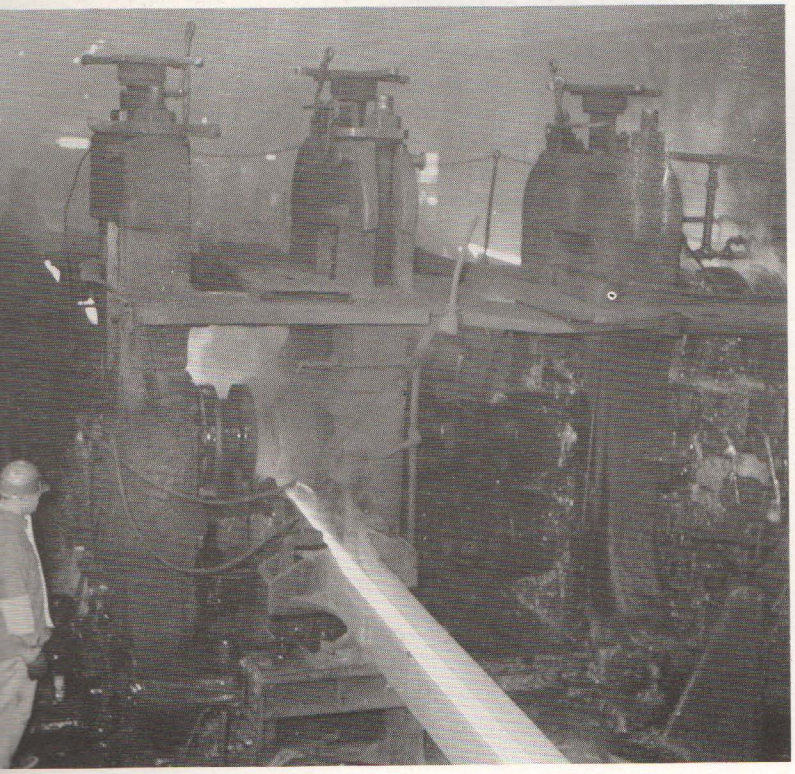
The rail "brand" is rolled into the web of the rail by means of letters and numbers cut into the periphery of the bottom roll. As illustrated, this "brand" includes the manufacturer's name, the year and month rolled, section designation and other identifications.

TYPICAL SYDNEY "BRAND"

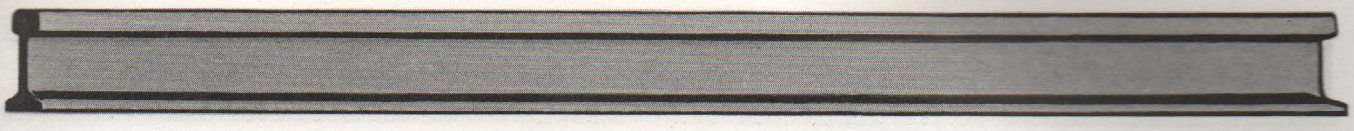
1	2	3	4	5	6	7
13201	SYDNEY	VT	132 lbs.	RE	1973	111

1. Manufacturer's weight and/or section number.
2. Manufacturer.
3. Vacuum treated.
4. Nominal weight per yd.
5. Type of rail.
6. Year rail rolled.
7. Month rail rolled.





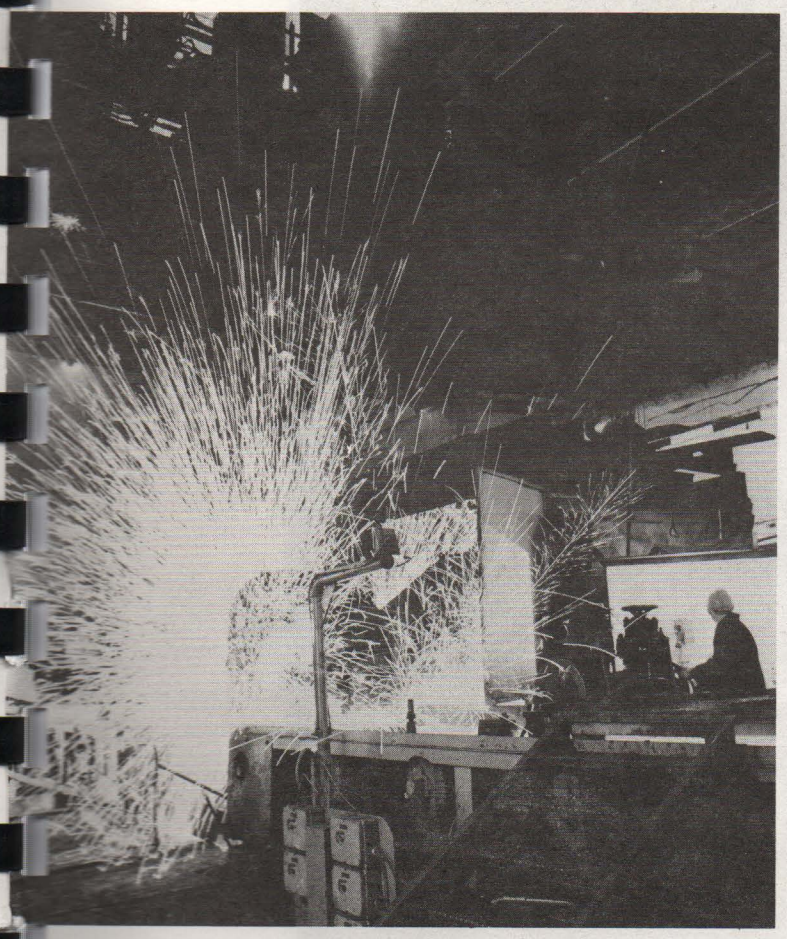
A rail emerging from the finishing pass in the rail mill. No further shaping is necessary and the rail is now ready for cutting and cambering.



CUTTING AND STAMPING

After leaving the final "pass" of the rail mill the rails are cut to length. Our standard rail length is 78 foot, although rails to a length of 82 foot (25 M) can be supplied. Cutting is done by a hot-saw mounted over the runout table beyond the finishing roll stand. In cutting these rails, allowance must be made for linear thermal contraction, which in a 78 foot rail is approximately 16 inches, but does vary within narrow limits according to the rail section and temperature.

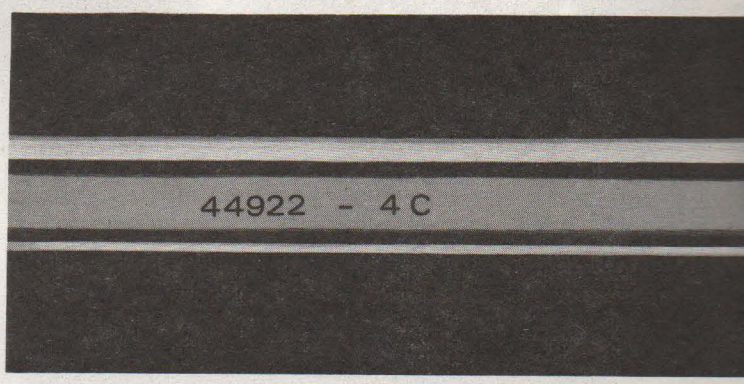
After cutting to desired length, the rails are hot-stamped with the Heat number, Ingot number and Rail letter. This identification is impressed on the web of the rail on the side opposite to the "brand" and is repeated several times on each rail as it passes under a rotating stamping head.



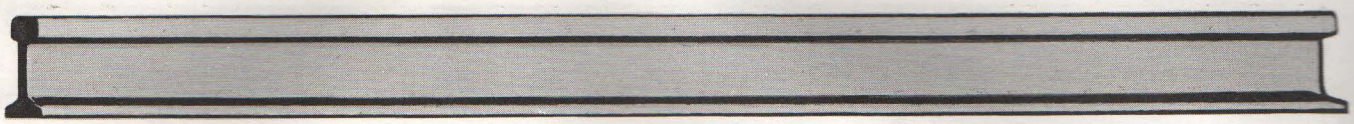
The job of cutting a rail to length, with a square end, is carried out with a "hot-saw". In cutting the hot rail to length allowances must be made for linear contraction upon cooling.

TYPICAL SYDNEY "STAMP"

44922	4	C
Heat No.	Ingot No.	Rail Letter



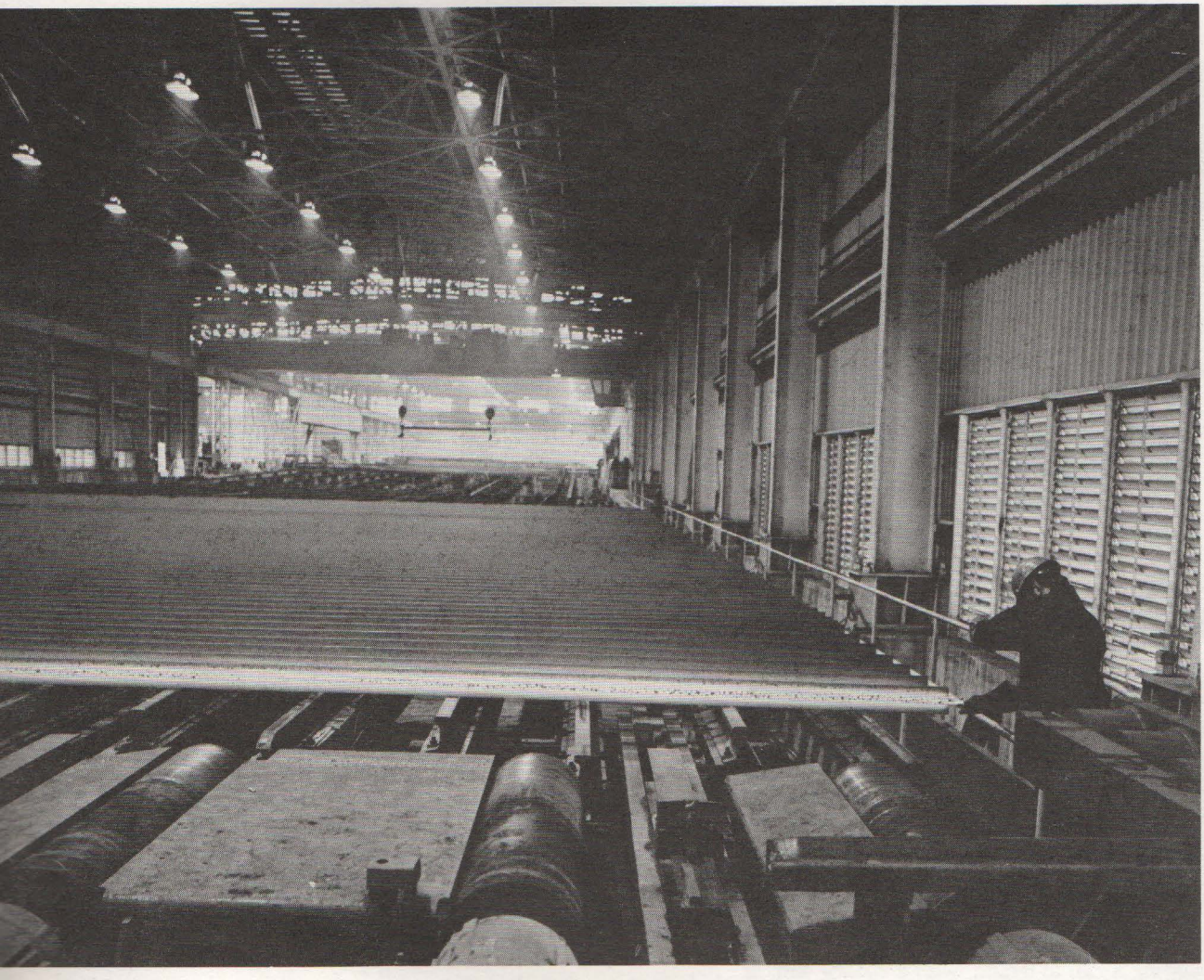
Before moving to the "Hot-beds", each rail is cambered by passing through Cambering rolls which bow the rails in a slight arc with the head on the convex side. This is done to offset the differential in contraction of the unequal masses of metal contained in the head, the web and the base of the rail.



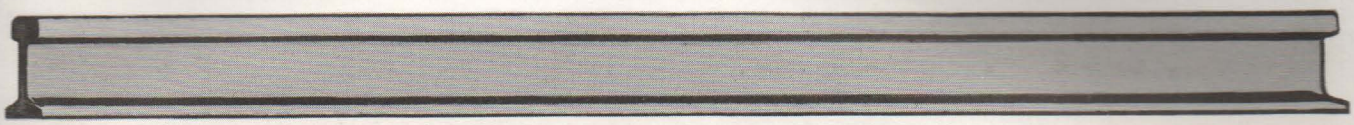
QUALITY CONTROL

Rail specifications are so exacting that utmost precision is necessary in the initial roll design, and in the subsequent inspection which is given to the rolled Rail with respect to section, size and contour.

The hot bed is the first check point for quality control after the cambering machine. Here the rails are checked for surface and end defects, tears, scratches, camber, line, brand and section. Information on any defects noted at this stage is immediately conveyed to the rail mill operators for corrective action.



View of transfer table, on lift and carry Hot-Bed. After rolling, the rails are automatically placed on this cooling bed, and while cooling, are transferred from the rolling mill to the finishing mill.

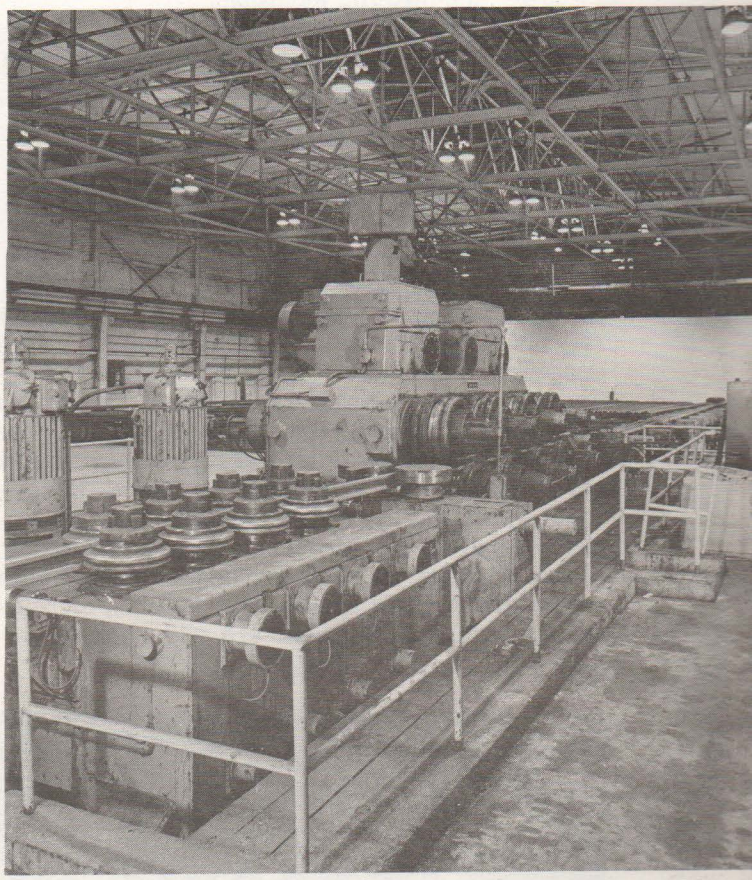


STRAIGHTENING

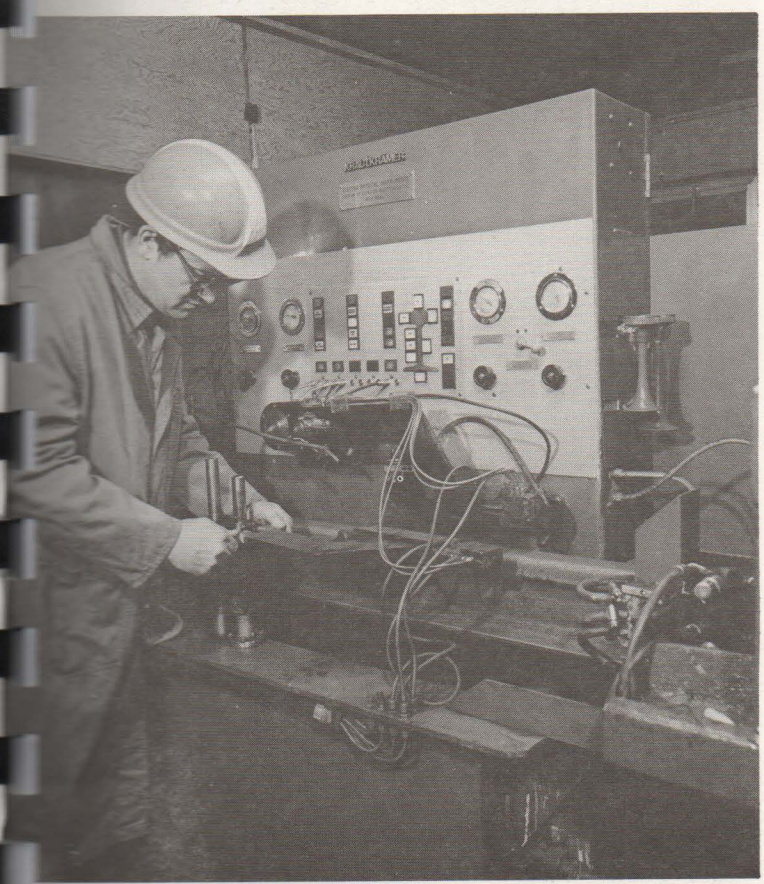
The rail is transported, from the end of the "lift and carry", by roller line to a second transfer table which positions the rail for the next process.

The demands for better end straightness, overall line and surface straightness has necessitated an improvement in facilities for finishing rails. In Sydney, Rails are straightened by means of an in line two-plane Wirth roller straightener, pictured at right. The ends are further straightened, when necessary, in hydraulic presses.

After this process is completed, each end is checked by straight-edge to ensure conformity to specification.



In this photograph one can see a rail being roller straightened.



Photograph above shows rail being ultrasonically inspected on our Krautkramer ultrasonic unit.

INSPECTION

Immediately after roller straightening, each rail is four-side visually inspected and ultrasonically inspected to ensure internal soundness.

The production of long-length rails virtually demanded the elimination of the control cooling process and substitution of vacuum degassing.

Vacuum treated rails are inspected on an in-line basis, in our finishing mill operation. The rails pass through an ultrasonic tester which automatically inspects them for internal defects.

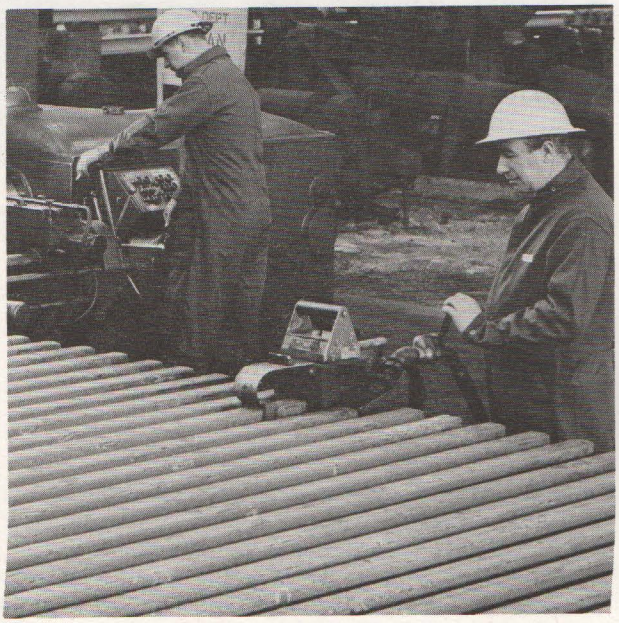
INSPECTION (Continued)

1. Piping defects in the Head and Web.
2. Gross non-metallic inclusions.
3. Shatter cracks in the Head.
4. Gross sub-surface non-metallic inclusions in the Web at each end of the rail.

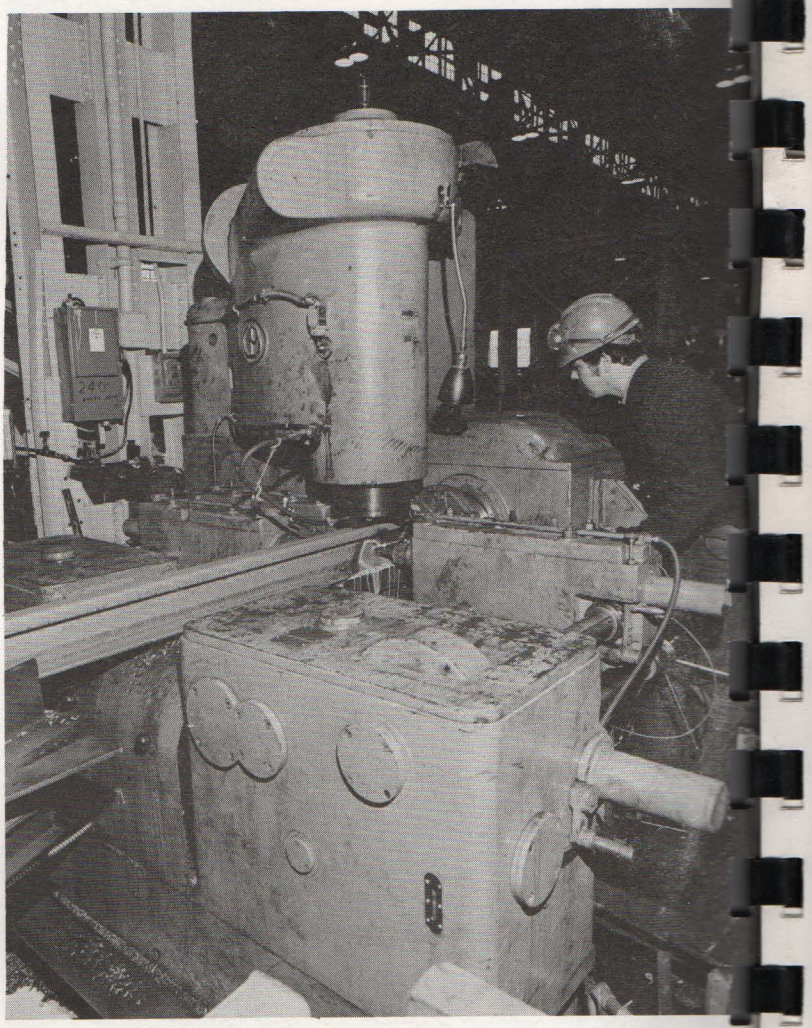
The ultrasonic testing system was designed by Kraut Kramer. It consists basically of an inspection bench and a double row 19" cabinet. A picture of the unit is shown on the preceding page.

DRILLING AND ENDING

From the Roller Straightener and ultrasonic unit, the next process in Sydney's modern and efficient rail finishing mill is "drilling and ending". This operation is carried out by four "drilling and ending" machines, which are so designed that the two operations of squaring the rail end and drilling the bolt holes, should the latter be required are carried out simultaneously. From these machines, the rails move along and the ends are checked for squareness. The drilling is checked for size and location. At this point, the rails are also measured for length as specified by the customer. Any rails not measuring up to all specifications are sent back for refinishing.



The end-hardening section at Sydney Works shows the operator with induction heating unit under his right hand and an air cooling unit under his left hand. The operator in the background is running a "drilling and ending" machine.



Above: one of Sysco's drilling and ending machines.

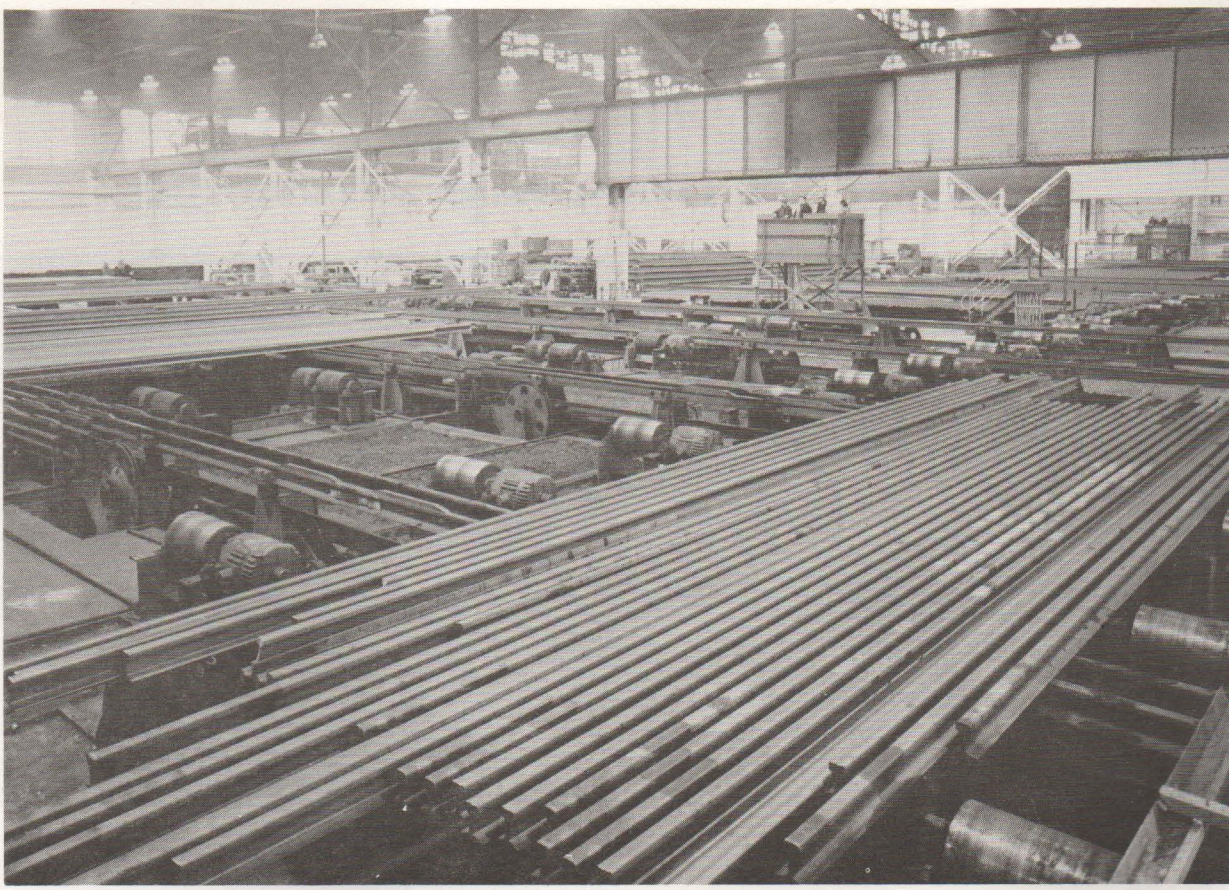
END-HARDENING

End-hardening is a heat treatment given to the top end surface of a rail head which makes it more wear-resistant, and most railroads now specify that rails be so treated.

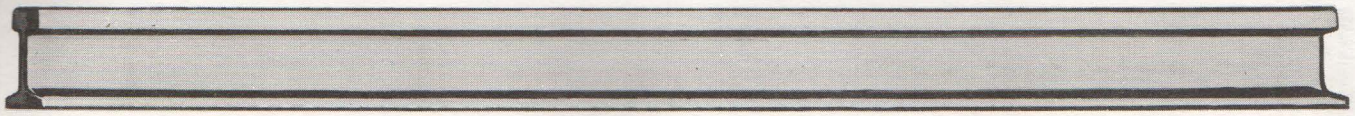
Sydney was one of the early producers of the end-hardened rail and their ability to meet these and other exacting specifications has enabled them to stay in the forefront as a rail producer.

The end-hardening process is carried out after the rail leaves the "drilling and ending operation" and consists basically of heating the full width of the rail head and then rapidly cooling it. The ends of the rail are bevelled (if so specified) and electrically powered induction heating heads are placed on these ends. When the heating cycle is completed the heating heads are replaced by air-quench heads. The heating and cooling time cycles are carefully controlled to assure a uniform end-hardened pattern. Specimens of end-hardened rails are carefully Brinell-tested for hardness, and sectioned to check the hardness pattern.

End-hardened rails have successfully demonstrated that such treatment reduces wheel-batter and chipping or spalling at rail joints even under most severe conditions.



This photograph shows a portion of Sysco's new finishing mill.



CLASSIFICATION

Most rail specifications call for a classification of rails to a prescribed standard. Sydney includes such classification as part of their inspection routine and facilities are flexible enough to cover any such requirements stipulated by a customer.

Rails are normally classified in the following manner.

No. 1 rails are those free from injurious defects of any kind.

No. 1 rails whose carbon and manganese content is above the mean of the specified range are called No. 1 High Carbon.

No. 1 rails less than the ordered length are called No. 1 short.

No. 1 "A" rails are the first rails from each ingot, after top discard.

All other No. 1 rails are called No. 1 Low Carbon.

No. 2 rails are those which:

—do not contain surface defects in such number or of such character as to render them unfit for recognized use.

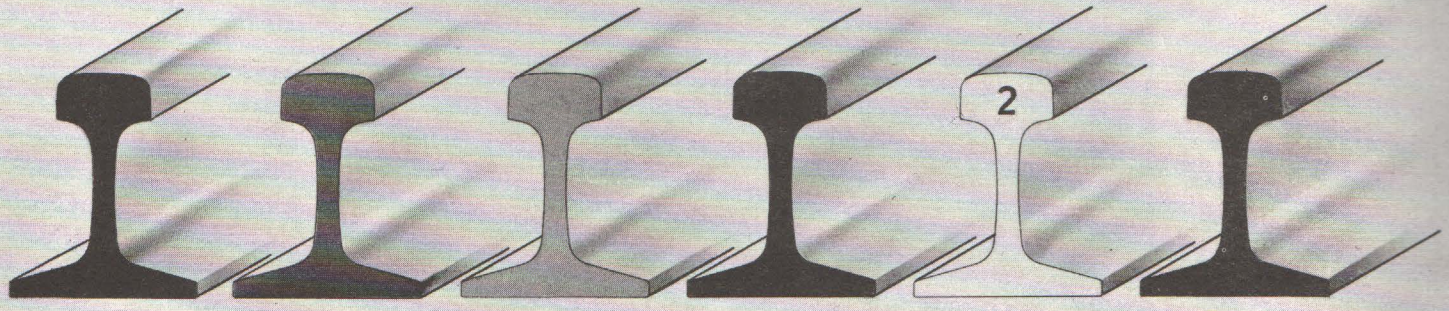
—arrive at the straightener with sharp kinks or greater camber than indicated by a middle ordinate of 6" (152.4mm) in 39 ft. (11.9M).

—are not hot stamped.

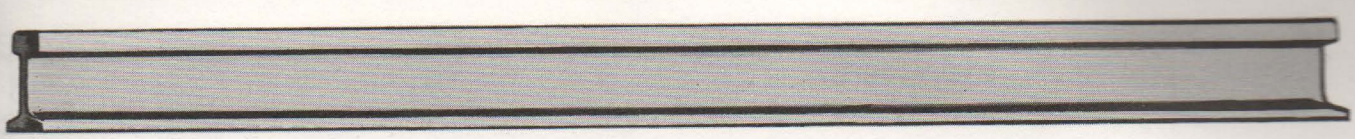
In order to facilitate the identification of each class of rails, the individual rail of each class will bear one distinct color of paint on the end face so that the pertinent class of rail is unmistakably marked.

Rails for welded track are **not** "end painted".

A TYPICAL PAINT MARKING CODE



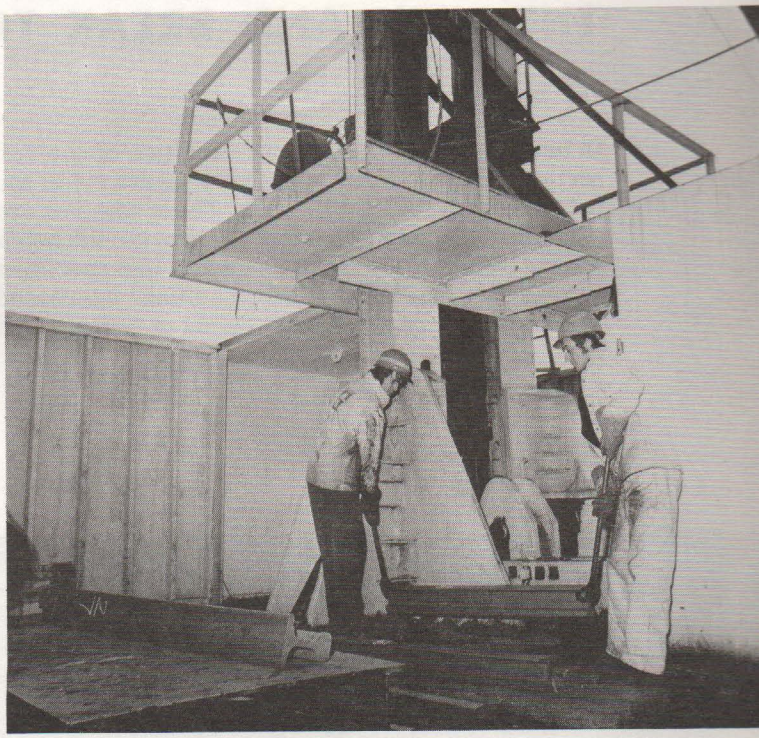
NO. 1	NO. 1	NO. 1	NO. 1	NO. 2	X-RAYLS
HIGH CARBON	SHORTS	"A" RAILS	LOW CARBON	ALL LENGTHS	ALL LENGTHS
BLUE	GREEN	YELLOW	PLAIN	WHITE	BROWN
END FACE	END FACE	END FACE	(NO PAINT)	(STAMPED #2 ON END FACE)	(STAMPED "X" ON END FACE)



THE DROP-TEST

In order to determine the ductility and resistance to impact of a rail, "drop-test" (falling weight test) specimens are cut from the top of the "A" rail of the designated drop-test ingots. These specimens are cut at the hot saw after the rail finishing pass, are subjected to slow cooling, and tested as specified using either our A.R.E.A. or British Standard type of drop-test machine.

These drop-test machines have adjustments for "height of drop" and distance between bearing supports. Test specimens are placed head up on the supports and are subjected to one blow from a "tup", falling free, from a specified height.



The photograph shows a rail section about to be placed in the drop test machine.

COMPARISON

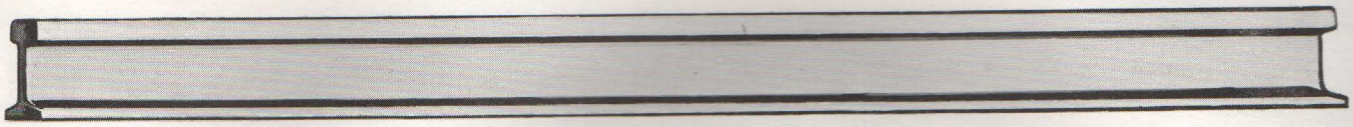
A.R.E.A., BRITISH STANDARD AND U.I.C. DROP-TEST REQUIREMENTS

SPECIFICATION AND DATE	SECTION	WEIGHT OF TUP		HEIGHT OF DROP		ENERGY OF TUP		BEARER CENTRES		RADII				WEIGHT OF ANVIL	
										BEARER		STRIKER		LONG TONS	METRIC TONS
		Lbs.	Kg.	Ft.	M.	ft./lbs.	Kg./M.	Ft.	M.	in.	mm.	in.	mm.		
A.R.E.A. – 1970	100	2000	950	19	5.8	38000	5510	3	0.91	5	127	5	127	8.93	9.1
	110	2000	950	20	6.1	40000	5795	4	1.22	5	127	5	127		
B.S. 11 – 1959	100A	2240	1016	26½	8.0	59360	8209	3½	1.07	3	76.2	5	127	12	12.2
	110A	2800	1270	26½	8.0	74200	10261	4	1.22	3	76.2	5	127		
U.I.C. – 1970															
Method A	54	2204	1000	18.42	5.67	40598	5670	3¼	1.00	3.9	100	3.9	100	9.82	10
Method B	54	2204	1000	26.32	8.10	58009	8100	3¼	1.00	3.9	100	3.9	100	9.82	10

NOTE: **The higher striking energy evident in the British Standard Test reflects the use of a "Softer" more ductile rail chemistry specification than used in the usual A.R.E.A. specification.**

The British Standard specification calls for an anvil foundation of concrete or masonry of not less than 25 tons having an area not less than 100 sq. ft. with tests taken from each 50 tons or part of 50 tons of each heat.

The A.R.E.A. specification calls for an anvil supported on springs mounted on a cast base plate bolted to timber grillage resting on masonry, with tests taken from the second, middle and last full ingot of each heat.



THE NICK AND BREAK TEST

In order to check the interior condition of the rail section, test specimens about 18" long are cut at the hot saw on all "A" & "B" rails. These samples are nicked on one side (while hot) to provide the notch for the break. If the fracture on any test specimen exhibits seams, laminations, cavities, interposed foreign matter or a distinctly bright or fine-grained structure, the rails represented are classified as X-Rayls.

If specified by a customer, progressive all ingot "nick & break" testing, with elimination of segregated rails, is performed in accordance with A.R.E.A. specifications.

LOADING AND SHIPPING

After the final inspection is completed, all the accepted rails are made up into slings and placed on cars for shipment to customer's destination, or are stocked in the Mill if awaiting shipment by water.

For shipment, the loaded rails are well secured to be moved by rail or water, to our many customers in Canada, United States, Mexico, Great Britain, France, South Africa, India, Chile, Pakistan, Bangladesh and other Countries.

To the left is a photograph showing Sydney Steel rails being loaded on a vessel for shipment to one of our many customers outside Canada.

RESEARCH AND DEVELOPMENT ON RAILS

Sydney has been in the rail business since 1905, and the fact that Sydney rails are in service in many countries speaks highly of the inherent rail quality. No product ever maintains quality without continued research and development. Perhaps the most significant advance in rail manufacture was the development of retarded cooling at Sydney in 1931. Although not as spectacular, there have been continual improvements in rail practice over the ensuing years. Such changes as improvements in melting and deoxidation practice, more accurate temperature control in melting and rolling, better control of section and straightness, can be cited.

In order to assist in combatting the effects of rail end batter in service, Sydney installed a system for end hardening rails. This system, in use for many years, has produced hundreds of thousands of end hardened rails acceptable to Canadian and other roads.

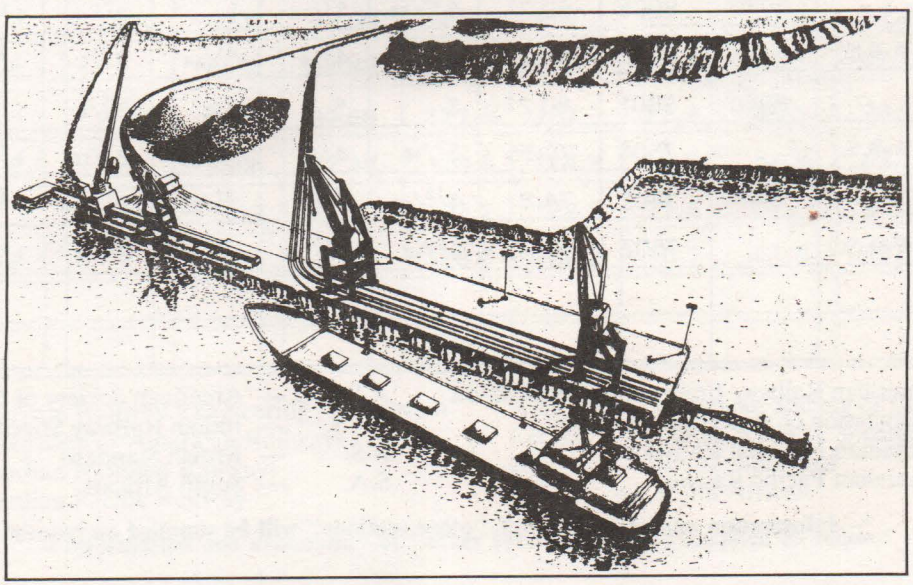
The existence of many miles of rails in the cold, northern regions of Canada and the known brittleness of rails at low temperatures created the need for tests of low temperature impact properties of rail steel. These tests were conducted on full scale sections in the Drop Test Machine at controlled low temperatures. Rail steel made to Canadian and American Chemistry specifications normally fail the A.R.E.A. drop test at temperatures ranging from zero to -25 degrees F. Test sections of Sydney rail are now in service which were produced to pass the standard A.R.E.A. drop test at minus 50 degrees F!

The rather rapid failure of rail — particularly in curves — due to wear and shelling on roads operating with heavy wheel loading has also been the subject of considerable study. Trial sections of special rails, induction hardened, flame hardened and alloy composition rails are now installed in track. These sections are being tested to determine their ability to combat wear and shelling.

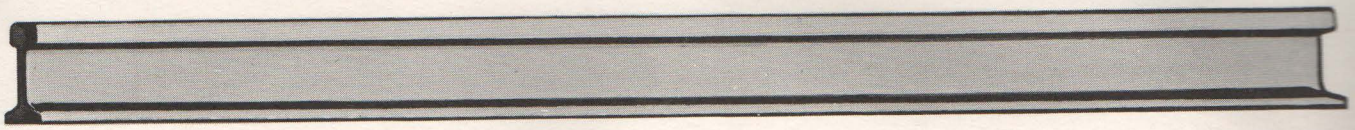
Alloy additions of controlled amounts of manganese, vanadium and chromium increase the strength and hardness of the as-rolled rail. Sydney's high strength rail contains selected amounts of such alloying agents so as to increase yield strength by more than 50 percent and hardness by around 40 percent.

Service trials of the high strength rail are currently under test in several railroads in Canada and preliminary results show considerable promise.

ARTIST'S CONCEPTION OF SYDNEY'S NEW PIER



This is an artist's conception of Sysco's new steel loading pier, which when completed will be capable of handling vessels drawing up to 41 feet of salt water.



RAIL DIMENSIONS OF STANDARD* SECTIONS

available from Sydney

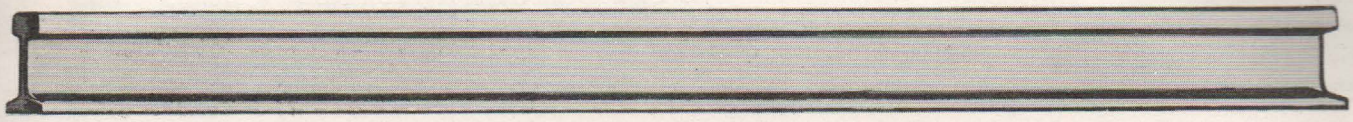
ENGLISH MEASUREMENT

CANADIAN AND U.S.A. SECTIONS	BRITISH AND OTHER SECTIONS	U.S.A. SECTION NUMBER	SYDNEY SECTION NUMBER	CALCULATED WEIGHT LBS./YARD	MEASUREMENT IN INCHES						
					HEIGHT	BASE WIDTH	BASE THICKNESS	HEAD WIDTH	HEAD THICKNESS	WEB THICKNESS	FISHING FIT
136 R.E.			13601	136.2	$7\frac{5}{16}$	6	$1\frac{3}{16}$	$2\frac{15}{16}$	$1\frac{15}{16}$	$\frac{11}{16}$	$4\frac{3}{16}$
132 R.E		13225	13201	132.1	$7\frac{1}{8}$	6	$1\frac{3}{16}$	3	$1\frac{3}{4}$	$\frac{21}{32}$	$4\frac{3}{16}$
	U.I.C. 60		U.I.C. 60	121.64	$6\frac{49}{64}$	$5\frac{29}{32}$	$\frac{21}{32}$	$2\frac{59}{64}$	2.0	$\frac{21}{32}$	3.52
115 R.E.		11525	11501	114.7	$6\frac{5}{8}$	$5\frac{1}{2}$	$1\frac{1}{8}$	$2\frac{23}{32}$	$1\frac{11}{16}$	$\frac{5}{8}$	$3\frac{13}{16}$
	105 I.R.S.		10501	104.6	$6\frac{9}{64}$	$5\frac{23}{64}$	$1\frac{9}{64}$	$2\frac{41}{64}$	2	$\frac{39}{64}$	3
	100 R-B.S.		10006	99.95	6	$5\frac{3}{4}$	$\frac{27}{32}$	$2\frac{3}{4}$	$1\frac{27}{32}$	$\frac{9}{16}$	$3\frac{5}{16}$
100 A.R.A.-A.		10020	10002	100.4	6	$5\frac{1}{2}$	$1\frac{1}{16}$	$2\frac{3}{4}$	$1\frac{9}{16}$	$\frac{9}{16}$	$3\frac{3}{8}$
100 R.E.		10025	10003	101.49	6	$5\frac{3}{8}$	$1\frac{1}{16}$	$2\frac{11}{16}$	$1\frac{21}{32}$	$\frac{9}{16}$	$3\frac{9}{32}$
100 R.E.-H.F.			10005	99.58	$6\frac{1}{16}$	$5\frac{3}{8}$	$1\frac{1}{16}$	$2\frac{39}{64}$	$1\frac{23}{32}$	$\frac{9}{16}$	$3\frac{9}{32}$
	96 S.A.		9601	95.82	$5\frac{7}{8}$	5	$\frac{31}{32}$	$2\frac{11}{16}$	$1\frac{43}{64}$	$\frac{9}{16}$	$3\frac{15}{64}$
	93 FRENCH		9301	93.38	5.709	5.276	.677	2.839 TO 2.441	1.856	.591	2.796
	90 A.-B.S.		9005	90.76	$5\frac{5}{8}$	5	$\frac{43}{64}$	$2\frac{5}{8}$	$1\frac{13}{16}$	$\frac{35}{64}$	$2\frac{25}{32}$
90 A.R.A.-A.		9020	9003	90.0	$5\frac{5}{8}$	$5\frac{1}{8}$	1	$2\frac{9}{16}$	$1\frac{15}{32}$	$\frac{9}{16}$	$3\frac{5}{32}$
	90 R-B.S.		9004	89.94	$5\frac{5}{8}$	$5\frac{3}{8}$	$\frac{13}{16}$	$2\frac{5}{8}$	$1\frac{23}{32}$	$\frac{35}{64}$	$3\frac{3}{32}$
85 CN/CP STD.			8501	85.1	$5\frac{1}{8}$	5	1	$2\frac{7}{16}$	$1\frac{7}{16}$	$\frac{9}{16}$	$2\frac{11}{16}$
	81 S.A.		8101	81.03	5	5	$\frac{49}{64}$	$2\frac{1}{2}$	$1\frac{19}{32}$	$\frac{35}{64}$	$2\frac{41}{64}$
80 A.R.A.-B.		8030	8005	80.7	$4\frac{15}{16}$	$4\frac{7}{16}$	1	$2\frac{7}{16}$	$1\frac{15}{32}$	$\frac{35}{64}$	$2\frac{15}{32}$
	80 A-B.S.		8002	80.24	$5\frac{1}{4}$	$4\frac{5}{8}$	$\frac{41}{64}$	$2\frac{1}{2}$	$1\frac{43}{64}$	$\frac{33}{64}$	$2\frac{19}{32}$
80 A.S.C.E.		8040	8001	80.2	5	5	$\frac{7}{8}$	$2\frac{1}{2}$	$1\frac{1}{2}$	$\frac{35}{64}$	$2\frac{5}{8}$
	75 A-B.S.		7504	75.55	$5\frac{1}{16}$	$4\frac{1}{2}$	$\frac{39}{64}$	$2\frac{7}{16}$	$1\frac{21}{32}$	$\frac{1}{2}$	$2\frac{15}{32}$
75 A.S.C.E.		7540	7503	74.8	$4\frac{13}{16}$	$4\frac{13}{16}$	$\frac{27}{32}$	$2\frac{15}{32}$	$1\frac{27}{64}$	$\frac{17}{32}$	$2\frac{35}{64}$
	75 R-B.S.		7502	74.87	$5\frac{1}{16}$	$4\frac{13}{16}$	$\frac{47}{64}$	$2\frac{7}{16}$	$1\frac{9}{16}$	$\frac{33}{64}$	$2\frac{49}{64}$

R.E. — American Railway Engineering Association
A.R.A. — Association of American Railways
C.N. — Canadian National Railways
C.P. — Canadian Pacific Railway

A.S.C.E. — American Society of Civil Engineers
I.R.S. — Indian Railway Specification
B.S. — British Standard
S.A. — South African

***—Information and availability of "other sections" will be supplied on request.**

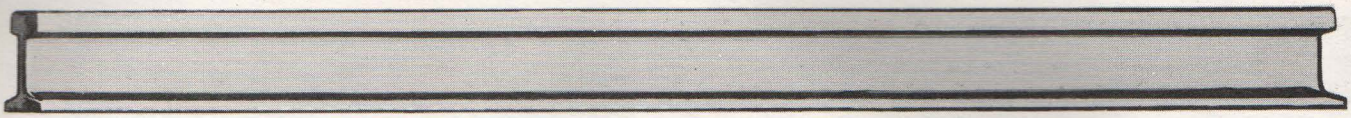


METRIC MEASUREMENT

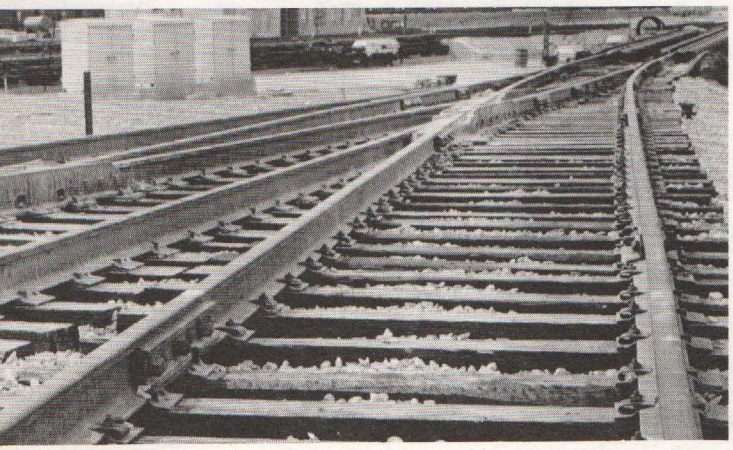
CANADIAN AND U.S.A. SECTIONS	BRITISH AND OTHER SECTIONS	U.S.A. SECTION NUMBER	SYDNEY SECTION NUMBER	WEIGHT KG. METER (APPROX.)	MEASUREMENTS IN MILLIMETERS (APPROXIMATE)						
					HEIGHT	BASE WIDTH	BASE THICKNESS	HEAD WIDTH	HEAD THICKNESS	WEB THICKNESS	FISHING FIT
136 R.E.				67.56	185.7	152.4	30.2	74.6	49.2	17.5	106.4
132 R.E.		13225	13201	65.52	181.0	152.4	30.2	76.2	44.5	16.7	106.4
	U.I.C. 60		U.I.C. 60	60.34	172.0	150.0	16.9	74.3	51.0	16.5	89.5
115 R.E.		11525	11501	56.89	168.3	139.7	28.6	69.0	42.9	15.9	96.8
	105 I.R.S.		10501	52.0	156.0	136.0	29.0	67.0	51.0	15.5	76.2
	100 R.-B.S.		10006	49.60	152.4	146.0	21.4	69.9	46.8	14.3	84.1
100 A.R.A.-A.		10020	10002	49.80	152.4	139.7	27.0	69.9	39.7	14.3	85.7
100 R.E.		10025	10003	50.34	152.4	136.5	27.0	68.3	42.1	14.3	83.3
100 R.E.-H.F.			10005	49.39	154.0	136.5	27.0	66.3	43.7	14.3	83.3
	96 S.A.		9601	47.35	149.2	127.0	24.6	68.3	42.4	14.2	82.0
	93 FRENCH		9301	46.30	145.0	134.0	17.2	60.8	47.1	15.0	71.0
	90 A.-B.S.		9005	45.02	142.9	127.0	17.1	66.7	46.0	13.9	70.6
90 A.R.A.-A.		9020	9003	44.64	142.9	130.2	25.4	65.1	37.3	14.3	80.2
	90 R.-B.S.		9004	44.64	142.9	136.5	20.6	66.7	43.7	13.9	78.5
85 CN/CP STD.			8501	42.16	130.2	127.0	25.4	61.9	36.5	14.3	68.3
	81 S.A.		8101	40.17	127.0	127.0	19.4	63.5	40.5	13.9	67.1
80 A.R.A.-B.		8030	8005	39.68	125.4	112.7	25.4	61.9	37.3	13.9	62.7
	80 A.-B.S.		8002	39.80	133.4	117.5	16.3	63.5	42.5	13.1	65.9
80 A.S.C.E.		8040	8001	39.68	127.0	127.0	22.2	63.5	38.1	13.9	66.7
	75 A.-B.S.		7504	37.48	128.6	114.3	15.5	61.9	42.1	12.7	62.7
75 A.S.C.E.		7540	7503	37.20	122.2	122.2	21.4	62.7	36.1	13.5	64.7
	75 R.-B.S.		7502	37.20	128.6	122.2	18.7	61.9	39.7	13.1	70.3

R.E. — American Railway Engineering Association
A.R.A. — Association of American Railways
C.N. — Canadian National Railways
C.P. — Canadian Pacific Railway
A.S.C.E. — American Society of Civil Engineers
I.R.S. — Indian Railway Specification
B.S. — British Standard
S.A. — South African

***—Information and availability of "other sections" will be supplied on request.**

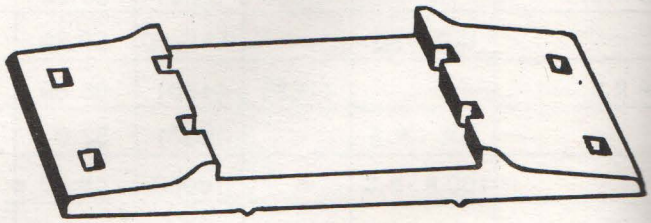


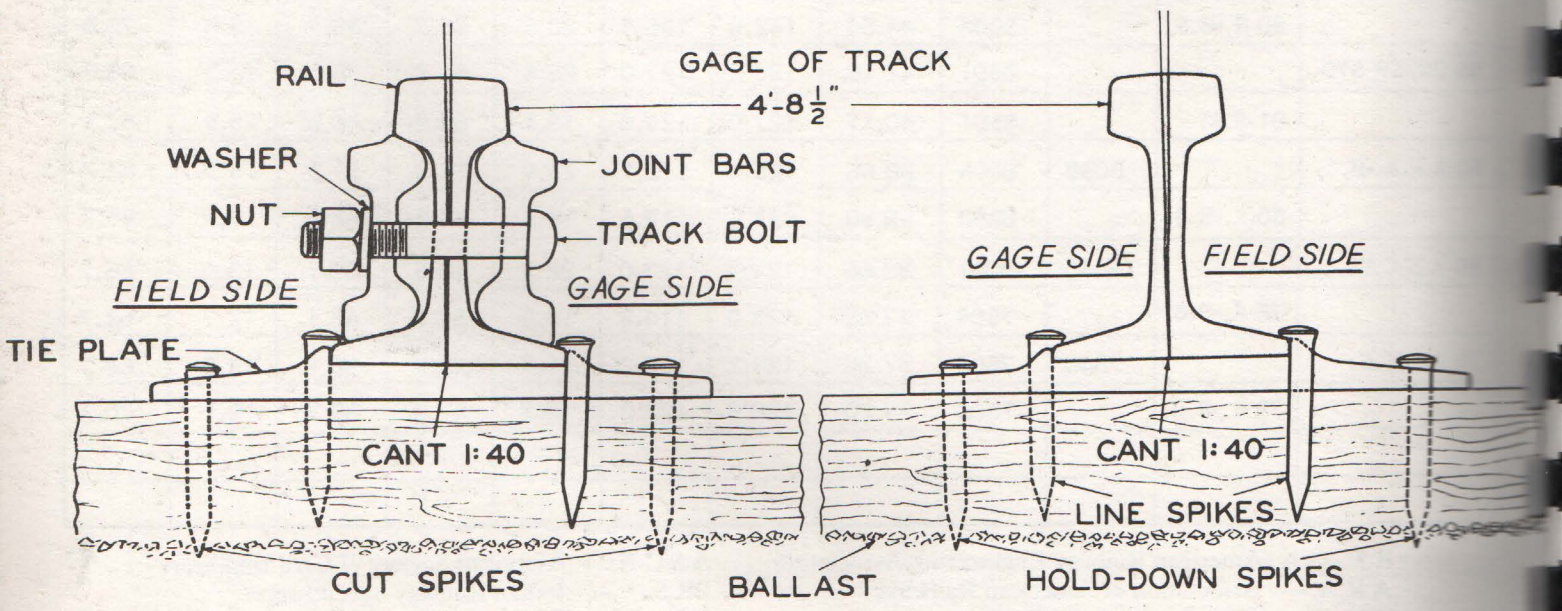
RAILROAD RAIL ACCESSORIES available from Sydney



Typical track layout showing nuts and bolts, spikes, joint bars, fish plates etc.

Tie Plates from 10" to 14¾" (254mm-375mm) in width.





CROSS SECTIONAL VIEW OF TYPICAL TRACK INSTALLATION

REPRODUCED BY COURTESY OF A.I.S.I.

STEEL PRODUCTS

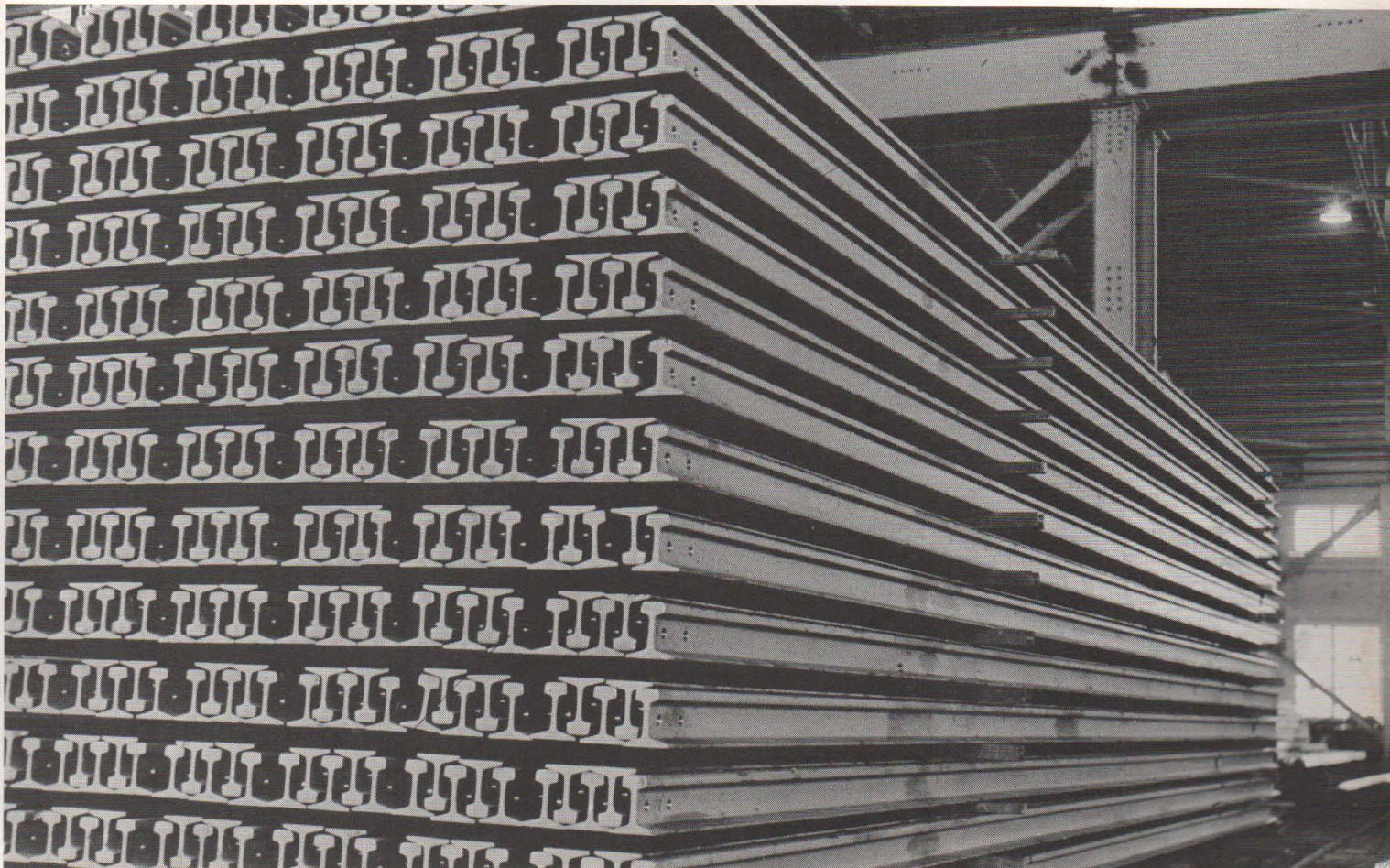
Ingots Blooms Billets

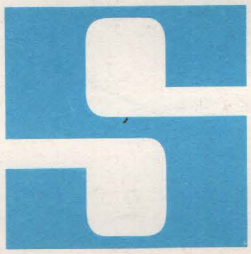
Slabs

Rails

Tie Plates

Reinforcing Bars





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